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GLASS

FOR CONSTRUCTION

LOF GLASS®

Parallel-O-Plate®
Heavy Plate
Heat Absorbing
Parallel-O-Grey®
Rough Plate
Mirropane®
Bullet Resisting
Safety
Tuf-flex®
Vitrolux®
Sheet
Thermopane®

AIA—File No. 26-A-1960

LIBBEY · OWENS · FORD GLASS COMPANY
TOLEDO 3, OHIO

1960

LIBBEY · OWENS · FORD

a Great Name in Glass

Glass is a 20th century pace-setting product in today's unprecedented business surge. The spirit which has made Libbey•Owens•Ford a leader in flat glass manufacturing is reflected in its development of new quality products and plant expansion. Beautiful design with walls of glass provides a bit of the aesthetic and the practical and puts enjoyment of living and working beyond the dreams of architects in past generations.

"Firsts" in L·O·F glass products . . .

Established research for automotive Safety Glass	1926
Pioneered straight-line mass production of ⅛" automotive plate	1929
"Picture Window" promotion begun, phrase later coined	1932
"Main Street" promotion	1936
Initiated storm sash promotion	1938
"More glass in small homes" promotion launched	1940
"Solar House" promotion launched	1940
National advertising of *Thermopane* for refrigeration	1941
"Visual Store Fronts" promotion	1941
Thermopane advertising to construction field begun	1944
Started *Thermopane* program for farm buildings	1946
Solar House architectural competition	1947
Established farm *Thermopane* research program	1950
Announced E-Z-Eye shaded windshield	1950
Thermopane Panel Window program began	1951
Introduced *Parallel-O-Plate,* first U.S. twin-ground polished plate glass	1954
Vitrolux for curtain walls announced	1956
Twin-ground Parallel-O-Grey polished plate introduced	1957

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L·O·F FLAT GLASS

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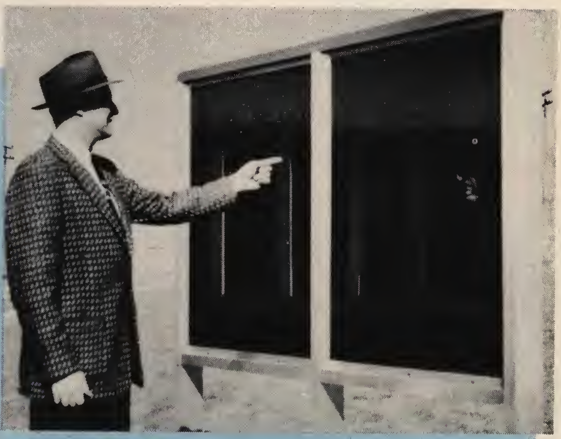
POLISHED PLATE GLASS

Produced under our rigid manufacturing specifications for grinding and polishing, the consistently high quality of L-O-F polished plate glass does much to contribute to better building design and to meet the architect's discriminating taste. Polished plate glass provides reflections that are more true, produces undistorted vision and adds a depth dimension to buildings. These characteristics are most important to consider as size of glass areas increase. See chart on page 5 for thicknesses, characteristics, etc.

1/4″ PARALLEL-O-PLATE®

¼″ ***Parallel-O-Plate*** provides perfection in polished plate glass. Produced by L-O-F in the United States since 1954, this superb glass is achieved by a twin-grinding process in which both sides of the glass are ground simultaneously by extremely accurate grinders weighing over 5 tons each. Such precision results in a more uniform thickness, more parallel surfaces, more perfect reflection and more freedom from distortion—important as window areas expand and extremely desirable for all mirror installations. These characteristics combine to make ***Parallel-O-Plate*** far superior to all other types of polished plate glass.



The glass in these two window frames is backed with black composition board to simulate the mirror effect of windows in a building. In the window at the left, glazed with *Parallel-O-Plate*, the reflections are mirror-perfect. In the other, glazed with sheet glass, note the distorted reflections of all straight lines.

HEAVY POLISHED PLATE

L-O-F heavy polished plate glass, in a range of thicknesses from ⅜″ through ¾″, is produced by the twin grinding process. Its uniform thickness and more parallel surfaces provide truer reflections. This is a distinct advantage for glazing uses where design requirements call for heavy plate glass. Specific thicknesses ⅜″ and ½″ are manufactured in large sizes to meet the growing architectural interest for uninterrupted expanses of glass. See chart on page 5.

qualities

Silvering Quality	—For finest mirrors and selective uses.
Mirror Glazing Quality	—For selected commercial mirrors.
Glazing Quality	—General glazing purposes.
Commercial Quality	—Heavy polished plate glass applications.

applications of various thicknesses

⅛″—Small panes, etc.
¼″—Windows of public and office buildings, residences and apartment buildings, mirrors, storefronts, showcases, shelving, table and desk tops.
⅜″ through ½″—For exceptionally large window areas to provide greater strength.
⅜″ through 1″—Shelves, furniture, desk and table tops, aquarium tanks, noise reduction, decorative panels, screens, etc.
NOTE: See *Tuf-flex* section on page 8 for all thicknesses except ⅛″.

HEAT ABSORBING polished plate

A product of special chemical composition, pale bluish-green in color, this glass absorbs a high percentage of the total radiant energy of the sun. Part of the absorbed heat is subsequently transferred to the interior, but a considerable portion is given off to the exterior, effecting a net reduction of the solar heat entering through the glass.

heat and light transmission

¼" thick heat absorbing glass transmits 46.3% of the total solar radiation (heat) as compared with a transmission of 79.9% afforded by regular plate glass ¼" thick. This resulting reduction of solar heat transmission produces a cooler atmosphere inside, resulting in lower initial cost for air conditioning equipment and its cost of operation. It also reduces sun and sky glare and provides light more restful to the eyes.

uses

L-O-F Heat Absorbing polished plate glass is particularly suited for glazing the windows of office and apartment buildings, hospitals, schools, factories, and other types of buildings where a reduction of solar heat and glare is desired. Along with these characteristics the reasonably high light transmission still provides good visibility and merchants whose wares are perishable will find L-O-F Heat Absorbing Polished Plate Glass beneficial for show windows. Because of its heat absorbing characteristics, this glass helps protect merchandise such as fruits, vegetables, candy and flowers by keeping them fresh longer.

For installations requiring added resistance against breakage, Heat Absorbing Glass is also available in *Tuf-flex* tempered plate—see page 9. For use of Heat Absorbing plate as outside light of *Thermopane* insulating glass, see table page 24.

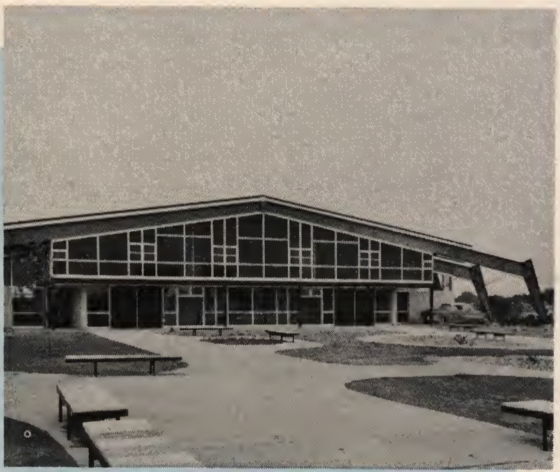
■ ■

¼" PARALLEL-O-GREY ®

Parallel-O-Grey is a twin ground neutral grey polished plate glass. It provides a reduction of glare and brightness, because of its lower light transmission, without sacrifice of color integrity. ***Parallel-O-Grey*** is also a heat absorbing glass effecting a net reduction of the solar heat entering through the glass. Its important feature of being twin ground assures a plate glass with relative freedom from visible distortion and being a tank glass, greater uniformity of color and quality is provided.

light and heat transmission

¼" ***Parallel-O-Grey*** polished plate glass transmits approximately 44% of average daylight (Illuminant C) as compared with a transmission of approximately 89% through regular ¼" polished plate glass and approximately 75% through ¼" Heat Absorbing polished plate glass. This lower light transmission results in reduction of glare and brightness. Its transmission of approximately 47% of the total solar radiation (heat) is comparable to the performance of ¼" Heat Absorbing polished plate glass.



These classroom view windows are glazed with L-O-F *Parallel-O-Grey*. San Angelo Senior High School, San Angelo, Texas. Architects: Caudill, Rowlett, Scott & Assoc. Associate architect: Max D. Lovett.

uses

L-O-F ¼" ***Parallel-O-Grey*** polished plate glass has been designed for glazing windows of office and apartment buildings, schools, hospitals, libraries and buildings of other types where significant reduction of glare and brightness is desirable. Along with these benefits, the pleasing neutral grey color of ***Parallel-O-Grey*** provides comfort in the field of vision. An additional advantage of ***Parallel-O-Grey*** comes from its heat absorbing quality providing benefits in lower costs of air-conditioning equipment and cost of operation. It is not recommended for storefront glazing where maximum visibility is desired. For added resistance against breakage, ***Parallel-O-Grey*** is also available in ***Tuf-flex*** tempered plate. See page 9.

SEE SUGGESTED SPECIFICATIONS ON PAGE 26

21/64″

ROUGH PLATE BLANKS regular and heat absorbing

Rough Plate Blanks result from the first step in the production of polished plate glass. These blanks have slight configurations on both surfaces producing a pleasing, translucent textured appearance with relatively high light transmission and good obscurity. The heavy (21/64″) thickness permits the use of large individual sheets if desired. Maximum size is 100″ x 144″. These features have resulted in a primary use as interior borrowed light partitions. Other uses include transom, sidelight and spandrel applications. Rough Plate Blanks are also available in *Tuf-flex*. See page 9.

Typical rough plate blank partition installation.

selection

type	thickness	thickness tolerance	maximum width & length		approx. weight lbs. per sq. ft.	average solar radiation transmittance values at normal incidence		
			standard	special		ultra-violet	illuminant C (avg. daylight)	total solar radiation*
regular	⅛″	±1/32″	72″ x 74″	74″ x 120″	1.64	75.9	90.6	86.1
parallel-o-plate†	¼″	±1/32″	124″ x 170″	124″ x 252″	3.27	67.8	89.1	79.9
twin ground†	⅜″	±1/32″	96″ x 120″	120″ x 264″	4.90	60.5	87.3	75.2
	½″	±1/32″	96″ x 120″	117″ x 300″	6.54	54.9	86.0	71.0
	⅝″	±3/64″	72″ x 120″	90″ x 132″	8.17	51.0	84.7	67.1
	¾″	±3/64″	72″ x 120″	90″ x 132″	9.81	47.6	83.3	63.3
regular	1″	±1/16″	42″ x 96″	48″ x 108″	13.08	42.8	78.2	55.5
parallel-o-grey†	¼″	±1/32″	96″ x 138″	100″ x 192″	3.27	39.0	44.2††	46.6**
heat absorbing	¼″	±1/32″	84″ x 120″	96″ x 138″	3.27	44.9	74.7	46.3**
rough plate blank regular	21/64″	±1/32″	80″ x 144″	100″ x 144″	4.29	63.4	88.3	76.7
heat absorbing	21/64″	±1/32″	80″ x 144″	100″ x 144″	4.29	37.4	71.5	41.5

*Solar radiation values are normal incidence transmittances for source that has energy distribution of the sun at 30° altitude (air mass equals two) (approximately 3% ultraviolet, 45% visible rays, 52% infrared).

**This average is subject to commercial variation, but all Libbey-Owens-Ford Heat Absorbing and Parallel-O-Grey Polished Plate Glass meets Federal Specification DD-G-451a which specifies total radiation not more than 0.50.

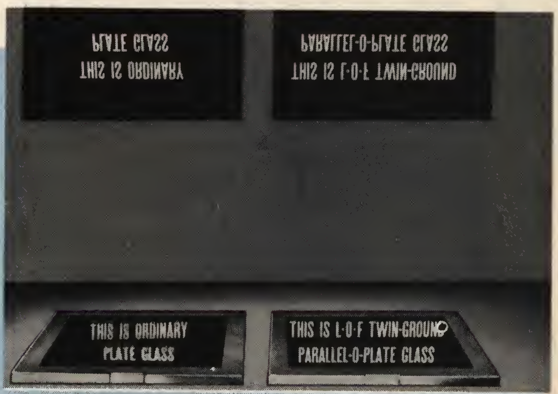
†¼″ Parallel-O-Plate, Parallel-O-Grey and items of heavy plate as indicated are manufactured by the twin ground process.

††Parallel-O-Grey meets the heat absorbing requirements of Federal Specification DD-G-451a of December 9 1949, Amendment 1, June 15, 1951, Page 7, Paragraph 3.7.1. It has not been designed to meet the requirement for luminous transmittance.

mirrors of PARALLEL-O-PLATE

Parallel-O-Plate mirrors provide an exactness of image and sparkling clarity that excels. Both surfaces of *Parallel-O-Plate* are ground simultaneously, resulting in surfaces parallel to a degree never achieved by any other method of making plate glass. The more parallel the surfaces, the more perfect the reflection.

Libbey-Owens-Ford Glass Company does not manufacture and sell chemically deposited mirrors for architectural purposes, but supplies *Parallel-O-Plate* glass to many of the leading mirror manufacturers.



Compare reflections of the upside-down signs in the mirror of conventional plate glass (left) and the mirror of *Parallel-O-Plate* (right.)

MIRROPANE®
transparent mirrors

Mirropane appears as a mirror when viewed from one side but is transparent from the opposite. Ideally, one side should be brightly lighted for the illusion of an opaque mirror, with dimmed lighting on the opposite side from which observers may view into the lighted area.

Where the necessary light intensity differential between the two areas involved is not available, *Mirropane* may be purchased manufactured with Parallel-O-Grey polished plate. Parallel-O-Grey reduces the light intensity differential to about 3 to 1.

If some degree of protection from impact is desired, ***Mirropane*** is available in a form of laminated Safety Glass where the coating may be between the lamination or on the outside. Where resistance to thermal shock and impact is desired, ***Mirropane*** can be supplied on tempered plate in thicknesses as specified on page 9.

Mirropane's durable coating of evaporated chromium alloy offers definite advantages over the chemically deposited mirrors on the market.

suggested uses

Residence entrance doors, hospital observation windows (particularly psychiatric), show windows, super markets, variety chain stores, department stores, commercial refrigerators, nursery doors in residences, toll houses, kindergartens, night clubs and taverns, security windows in government offices, banks, post offices, FBI offices, police departments, private offices, factories and institutions, and colleges and universities (psychology departments).

installation

Mirropane should be installed with its reflective (coated) side toward the area into which observation is desired, that is, toward the brightest side.

sizes

L-O-F ***Mirropane*** is furnished in stock sizes of ⅛" and ¼" polished plate glass or ¼" Parallel-O-Grey polished plate glass and in any size up to a maximum of 30" x 40" in ⅛" thickness and 60" x 80" in ¼" thickness. Larger sizes available on special order.

BULLET RESISTING

Bullet Resisting plate glass is composed of a minimum of four layers of glass and a minimum of three layers of Hi-Test plastic. Available in all thicknesses and sizes shown in the selection chart opposite, 1-3/16", 1-9/16", 1-3/4" and 2" thicknesses are available to Underwriters' Laboratories specifications for indoor and outdoor installations in bandit-resisting enclosures.

protective value

Bullet Resisting glass is clear and, in many installations, cannot be detected without close inspection. To persons unacquainted and unfamiliar with this product, it appears as an ordinary pane of glass. Any installation would pay for itself in protection of valuables, customers and workers if a single robbery were thwarted because of its use.

uses

Extensively used for glazing bank teller cages, cashier booths, jewelry store display cases, and observation windows in pressure test chambers.

SAFETY GLASS

Safety Glass is made of two lights of polished plate or sheet glass bonded by tough transparent plastic, and is available in types, thicknesses and sizes shown in the selection chart opposite. The interlayer is a carefully plasticized polyvinyl butyral resin which has unusual strength, elasticity and adhesion. When fractured, the particles of glass tend to adhere to the plastic, affording maximum protection against flying glass fragments.

uses

An established standard in the automotive and transportation industries for years, improved techniques in bending have now broadened its usefulness.

In building construction, for exterior glazing precaution must be observed in setting specifications because of possible deteriorating effects from the chemical action of some glazing compounds. We suggest, therefore, that our engineers be consulted before selecting for exterior use.

SEE SUGGESTED SPECIFICATIONS ON PAGE 26

From the lighted side this *Mirropane* window becomes a gleaming wall mirror. Architects: Eschweiler & Eschweiler, Milwaukee, Wisconsin.

These Wisconsin State College students can observe children at work without the youngsters knowing it. Also used in security windows and in psychiatric study.

thickness	thickness tolerance	maximum standard size	dimensional tolerance	net wt. lbs. per sq. ft. unpacked
¾"	±1⁄16"	72" x 138"	+0-⅛"	9.81
⅞"	+⅛"-0	72" x 138"	+0-⅛"	11.45
1"	+⅛"-0	72" x 138"	+0-⅛"	13.08
1 3⁄16"	+⅛"-1⁄16"	72" x 138"	+0-⅛"	15.51
1 9⁄16"	+1⁄16"-⅛"	see below	+0-⅛"	20.44
1¾"	+⅛"-1⁄16"	see below	+0-⅛"	22.89
2"	+3⁄16"-1⁄16"	see below	+0-⅛"	26.16
2½"	+3⁄16"-1⁄16"	see below	+0-¼"	32.70
3"	+3⁄16"-1⁄16"	see below	+0-¼"	39.24

Thickness 1 9⁄16" through 3" max. width 72", max. length 138". Limited to 1100 pounds weight per light. Following table to apply.

thickness	max. width when max. length is required	max. length when max. width is required
1 9⁄16"	56" x 138"	72" x 106"
1¾"	50" x 138"	72" x 96"
2"	44" x 138"	72" x 84"
2½"	34" x 138"	72" x 66"
3"	28" x 138"	72" x 56"

Bullet Resisting glass offers needed protection to tellers in drive-in depositories like this.

types	thickness	thickness tolerance	max. area	net. wt. lbs. per sq. ft.
thin safety sheet	5⁄32"	−1⁄32"	7 sq. ft.	1.92
S. S. safety sheet	7⁄32"	±1⁄32"	15 sq. ft.	2.49
combination safety sheet (S.S. & D.S.)	15⁄64"	±1⁄32"	15 sq. ft.	2.91
D. S. safety sheet	¼"	±1⁄32"	15 sq. ft.	3.32
E-Z-Eye safety sheet	15⁄64"	±1⁄32"	10 sq. ft.	2.91
safety plate (clear and E-Z-Eye)	¼"	±1⁄32"	72" x 138"	3.16
heavy safety plate	⅜"	±1⁄32"	72" x 138"	4.88
	½"	±1⁄16"	72" x 138"	6.54
	⅝"	±1⁄16"	72" x 138"	8.13
	¾"	±1⁄16"	72" x 138"	9.81
	⅞"	±1⁄16"	72" x 138"	11.45
	1"	±1⁄16"	72" x 138"	13.08

Safety Glass in elevator, recessed in exterior wall of Oakland, Calif., apartment building. Architect: Values, Inc., Berkeley.

TUF-FLEX®
tempered plate

Tuf-flex is tempered polished plate glass made by a process of reheating and sudden cooling. As a result, the outer surfaces are in a state of high compression while the central portion remains in tension, producing a condition highly resistant to breakage. Tempered glass is not as flat as ordinary plate glass particularly along the edges, but the deviation is so slight it is not objectionable. Libbey-Owens-Ford Glass Company assumes no responsibility regarding breakage or installation.

properties

Tuf-flex is 3 to 5 times stronger than plate glass of the same area and thickness in sustaining loads and resisting fracture due to strain—approximately 3 to 5 times more resistant to impact shock from blunt objects—4 times more resistant to thermal shock. With all these added advantages, it still retains the same appearance, clarity, hardness and coefficient of expansion as regular polished plate glass. Although *Tuf-flex* withstands temperature differentials up to 400° F., it cannot be considered a fire retardant.

uses

- Visual entrance doors in all commercial, public, institutional and industrial buildings.
- Windows in gymnasiums and sports arenas.
- Jails, hospitals and mental institutions.
- Enclosures in museums, zoological gardens and aquariums.
- Backboards for basketball and handball.
- Balustrades.
- Counter tops and show cases.
- Push and kick plates on doors.
- Ship's glazing.
- Lenses for searchlights, floodlights and spotlights.
- Sterilizing ovens.
- Windows in oven doors.
- Peep hole glasses in furnaces and lehrs.
- Steam and oil pressure gauge covers.

for general glazing

The advantages of *Tuf-flex* tempered plate glass have been proven wherever frequent breakage has made reglazing a constant expense. Although not unbreakable, it is much more resistant to bending stresses than polished plate glass, and unlike ordinary glass, it disintegrates into small crystals when its limit of resistance is reached.

special shapes

Tuf-flex can be ordered in circles, squares, rectangles and special shapes cut to pattern, in a variety of edge finishes. However, since it cannot be cut after tempering, exact sizes required must be specified, and intricate designs should be submitted for approval.

for glass doors

Tuf-flex tempered polished plate glass doors are the designer's answer to his need for building entrances offering an unobstructed, inviting view of the interior. They have the durability and strength to withstand the heaviest traffic demands and provide more than normal protection against burglary or vandalism. *Tuf-flex* doors are adaptable to various types of alarm systems and panic hardware. Definite schedules of insurance rates may be obtained from any agency.

fittings

Doors are furnished with either continuous channel or corner fittings at top and bottom, as shown on opposite page, and are available in aluminum, bronze, or stainless steel in all standard finishes. Center lock and strike fittings may be located on the swing edge, or if desired lock and/or bolts may be placed in top and bottom fittings.

If approved by L-O-F, custom fittings furnished by others may be applied to the glass at our factory. Concealed door holders can only be used with continuous top channels. Applied on the tempered glass at the factory, fittings cannot be changed or altered at the point of installation without possible damage to the glass.

SEE SUGGESTED SPECIFICATIONS ON PAGE 26

selection

kind	thickness	max. size*	thickness tolerance	dimensional tolerance	wt. per sq. ft.
regular polished plate glass	¼", ⅜", ½" ⅝", ¾" 1"	72" x 120" 72" x 120" 42" x 96"	±1/32" ±3/64" ±1/16"	±1/16" ±1/16" ±1/16"	See plate glass chart on page 5
parallel-o-grey	¼"	72" x 120"	±1/32"	±1/16"	
heat absorbing	¼"	72" x 120"	±1/32"	±1/16"	
rough plate blanks					
regular	21/64"	72" x 120"	±1/32"	±1/16"	
heat absorbing	21/64"	72" x 120"	±1/32"	±1/16"	

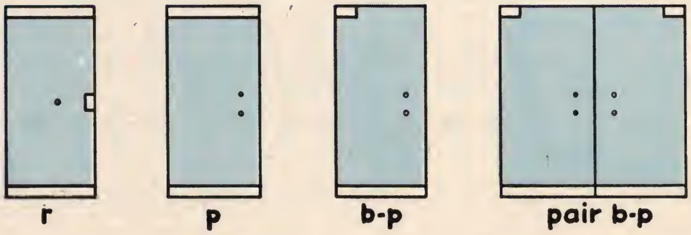
*minimum width—2"

Tuf-flex was specified for this multi-purpose school room next to playground area. Architect: John Lyon Reid, San Francisco.

strength comparison

	¼" plate	¼" Tuf-flex
modulus of rupture (Avg.) lbs./sq. in.	6,000	30,000
resistance to thermal shock	100°F.	400°F.
impact comparison 2 lb. steel ball	Avg. 8"	Avg. 44"
height dropped 11 lb. shot bag	Avg. 32"	Avg. 96"

types



Shown above are the more commonly used types. A total of 16 types are offered in standard or special sizes. Maximum width 48". Maximum height 108". Thickness ½" or ¾"

standard sizes

29 13/16"	x 83 3/16"	35 13/16"	x 83 3/16"
29 13/16"	x 83 11/16"	35 13/16"	x 83 11/16"
30"	x 84"	36"	x 84"

installation

Tuf-flex doors are installed on standard center or off-set pivot hinges and are equipped with an adaptor plate at the bottom and oil-lite bearing at the top to receive the pivot hinges. Door frames or jambs of aluminum, bronze, stainless steel or other metal are preferable.

Tuf-flex Polished Plate Glass doors substantially reduce the susceptibility to breakage and furnish polished clarity to this store entrance.

For detailed information on *Tuf-flex* Doors see Sweet's file for architects 16d/Lib.

VITROLUX®
for curtain walls

Vitrolux is heat-strengthened, ¼″ polished plate glass with the added feature of vitreous color, fire-fused on the back surface to become an integral part of the glass. It provides a hard, nonporous polished surface which resists most atmospheric acids and temperature changes. *Vitrolux* will not fade, swell, shrink, warp, craze or deteriorate and is easy to keep clean.

density

Opaque only. Scattered "pin holes", particularly in darker colors, and some non-uniformity of ceramic coating thickness will be allowed. When viewed against a strong light, a mottled or streaked effect is evident. For this reason, *Vitrolux* should not be used as a glazing material such as plate glass, but used in front of a back-up of masonry, fiber glass insulation, etc.

general applications

Vitrolux is used as spandrels or for entire facades in conjunction with metal framing of curtain-wall design in the construction of storefronts and other buildings (commercial or institutional), industrial plants, showrooms, laboratories, etc.

dimensions

maximum standard size: 72″ x 108″
thickness: ¼″ polished plate glass (tolerance +1/64″,—1/32″)
dimensional tolerance: $+0'',-\frac{3}{16}''$

colors

Color is sunfast and offers the same natural resistance to weathering, crazing and checking as ordinary glass. Opaque only, the sixteen standard colors plus black and white are:

Brick Red
Jade Green
Fawn
Colonial Blue
Buff
Golden Olive
Sage Green
Charcoal
Ice Green
Turquoise
Spruce
Hunter Green
Silver Gray
Gunmetal
Cinnamon
Chocolate

installation

Vitrolux should be placed on two setting blocks at the quarter points of the bottom edge of panel. Caulking compound, approved by the architect, is to be placed in the rabbets having removable stops on all four sides of opening. Rabbet details should be such that the glass will not become load bearing. Glass-face to stop-face clearance should be ⅛″ to ¼″ inside and out. Vitrolous should not contact other materials except in the glazing rabbet.

Colonial blue *Vitrolux* was selected for this new office building. Architect: H. L. Vokes Co., Cleveland.

See Sweet's file for architects 3e/Li or ask for catalog VX-1 and detail drawings of typical mullions and vertical sections, VX-2.

SPECIAL TREATMENTS

decorative glass

Three types of sandblast decorative finish are available for polished plate:

Surface sandblast—in grades from very slight to complete removal of polished surface.

Shaded sandblast—gradations in shading from natural surface to complete obscuration of polish.

Deep sandblast—decoration cut below surface of glass without modeling or gradation.

bent glass

Bent glass shapes are produced by causing flat glass to form in a mould by the action of heat and gravity only. It is not a machined product, and is subject to more distortion and wider tolerances than flat polished plate or window glass.

explanation of bent glass diagrams

Dimensions on diagrams are to illustrate maximum limits of proportions. Radii of curves may not be less than 6″. Radii should be specified to outside surface of glass. Maximum rise of bends J and K must not exceed 36″. Depth of G bends not to exceed 1 in 16; example, pane 64″, depth 4″. Large flat portions of bent glass cannot be kept entirely flat and should be ordered as separate lights. Requirements for bends in glass of greater thicknesses or for larger dimensions than those listed at right should be submitted for consideration.

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

SHEET GLASS

Flat drawn sheet glass, representing the result of more than 30 years of quality glass manufacturing, is exceptionally transparent and has a natural fire-finished surface. L-O-F uses its own exclusive flat drawn process in manufacturing sheet glass. The result is a better annealed window glass that is less subject to breakage in cutting. Shipped in soundly-constructed boxes, sheet glass is given neat, clean and practically moisture-proof protection.

grading qualities

"AA"—Specially selected glass for highest grade work.
"A"—Select glass of superior glazing quality.
"B"—Suitable for general glazing purposes.
Greenhouse—Double strength thickness available in sizes shown in selection chart below.

types and general uses

The following types are available in the thicknesses, qualities and sizes shown in the selection chart below.

window glass—used for glazing windows, doors and storm sash in homes, apartments, and other types of buildings. Single strength thickness bears a red label; double strength is identified by a blue label.

heavy sheet glass—for glazing windows and doors where greater strength is required, but where slight distortion is not objectionable; shelving, display cases, window ventilators, jalousies and furniture tops. Heat absorbing heavy sheet is also available.

picture glass—for covering pictures, photographs, maps and prints; projectorslides, novelties, instrument dials, etc.

selection

types	classification	quality	thickness	approx. wt. sq. ft. in ounces	maximum sizes* (under normal conditions)	avg. solar radiation		
						ultra-violet	illuminant C (avg. daylight)	total solar radiation†
window	single strength	AA, A, B	.085—.100	19.50	90 united in.**	76.6	90.8	87.3
	double strength	AA, A, B	.115—.133	26	120 united in.**	73.4	90.4	85.7
	double strength	Greenhouse	.115—.133	26	16" x 18", 18" x 20", 16" x 24", 20" x 20"	73.4	90.4	85.7
heavy sheet	3/16"	AA, A, B	.182—.205	40	76" x 120"	68.8	89.6	82.9
	7/32"	AA, A, B	.205—.230	45	76" x 120"	66.8	89.2	81.5
	7/32" heat absorbing	Standard	.205—.230	45	max. 50 sq. ft. per lt.	47.5	76.6	51.2††
picture		AA, A, B	.043—.053	9 to 11	60 united in.**	81.6	91.5	89.6
		AA, A, B	.058—.068	12 to 14	60 united in.**	79.9	91.3	88.8
		AA, A, B	.070—.080	15 to 17	60 united in.**	78.1	91.0	88.0

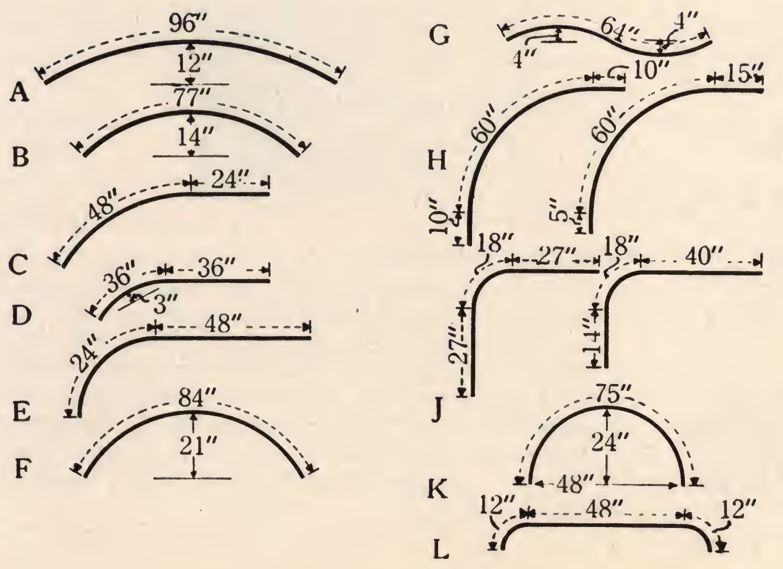
*All sheet glass has a characteristic surface wave, which is more apparent in larger sizes. This should be taken into consideration in the kind of glass you specify.

†Solar radiation values are normal incidence transmittances for source that has energy distribution of the sun at 30° altitude (air mass equals two) (approx. 3% ultraviolet, 45% visible rays, 52% infrared).

**United inches is sum of width plus length.

††On the basis of 1/4" thickness, this glass transmits less than 50% total radiation as required by Federal Specification DD-G-451a.

maximum sizes of bends (in inches)*



Types A, B, C, D, E, F, H, J

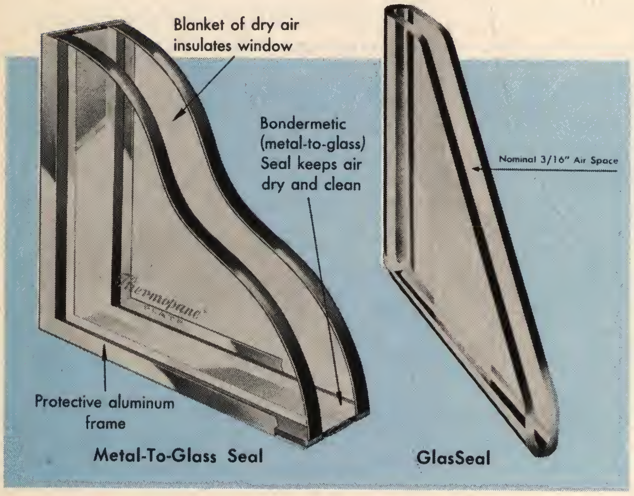
	Girth	Height
Regular Plate **1/8"** **1/4"**	60 or 48 144 or 120	48 or 60 120 or 144
Heat Absorbing	96 or 138	138 or 96
Single Strength **Double Strength**	24 60 or 48	48 48 or 60
Heavy Sheet **3/16"** **7/32"**	60 84	84 96

Types G, K, L

Same As Above Except

Regular Plate **1/4"**	110	144

*36 inch maximum rise regardless of type of bend.


Blanket of dry air insulates window
Bondermetic (metal-to-glass) Seal keeps air dry and clean
Nominal 3/16" Air Space
Thermopane PLATE
Protective aluminum frame
Metal-To-Glass Seal
GlasSeal

BONDERMETIC SEAL

Thermopane was the first successful, mass-produced, insulating unit of its kind for general use. It is a factory-built glass unit composed of two or more lights of glass separated by ¼" or ½" of dehydrated captive air, hermetically sealed around the edges at the factory with a metal-to-glass bond. The edge is further protected by a metal channel which insures maximum glass strength, provides greater ease of handling and minimizes the chance for edge chipping during installation. The glass is specially washed, the air scientifically cleaned and dried, and the Bondermetic Seal® applied at atmospheric pressure. The unit is not vacuum sealed.

GLASSEAL

GlasSeal® *Thermopane* units are available in either two panes of DSA or SSA window glass, both with $\frac{3}{16}$" air space. Use is limited to altitudes of not over 3,000 feet.

GlasSeal units fabricated with DSA window glass are made in sixty-five standard sizes (see page 25), covering a wide range of large-volume popular types of windows, ranging from 14" to 38" in one direction to 62" in the other direction within a total area of 1,440 square inches.

GlasSeal units fabricated with SSA window glass are available at this time in 28 standard sizes (see page 25) ranging from 20" to 40" in width to 16" to 28" in height within a total area of 1,120 square inches. SSA units are lighter in weight than DSA units of the same size, but the insulating efficiency is as high. A sash manufacturer can design and engineer a double-hung sash of standard thickness which can be properly balanced.

Units of *GlasSeal*-SSA weigh slightly over 10 ozs. less per sq. ft, than *GlasSeal*-DSA units. A comparison of thickness is given in the following table:

types of GlasSeal	unit thickness	wt. per sq. ft.
single strength	.375" ± .050"	2.4 lbs.
double strength	.450" ± .050"	3.05 lbs.

NOTE: See table on page 24 for complete data on types of glass in *Thermopane*.

SSA and DSA units are available in non-standard sizes in minimum quantities of 500 per size, subject to factory approval. **For further information, contact your nearest LOF District Office.**

Thermopane, being factory-fabricated, cannot be altered after manufacture without damaging the unit.

All *Thermopane* units are now inscribed with the word "Thermopane" in the lower right-hand corner. This inscription will be from 1" to 1¼" in length depending on the size of the unit and will be located just above and to the left of the sash line after glazing.

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characteristics

air space

Metal seal *Thermopane* is manufactured with ¼" and ½" air spaces only. GlasSeal *Thermopane* is manufactured with 3/16" air space only. For air space efficiency, see table on page 13.

quality of glass

Sheet (Window Glass)	"A" Quality only
Polished Plate, Regular	Glazing Quality
Parallel-O-Grey Plate	Glazing Quality
Heat Absorbing Plate	Glazing Quality
Tuf-flex	Standard Quality

combinations of glass

Thermopane units are available in various glass combinations, but glass thicknesses in the same unit cannot vary over 1/16". For example, a unit cannot be manufactured with one light of ¼" thickness and one light of ⅛" thickness.

kinds and thicknesses of glass

	kind	thickness
Libbey-Owens-Ford	*Sheet (Window Glass)	
	Single Strength "A"	3/32"
	Double Strength "A"	⅛"
	3/16" Heavy Sheet	3/16"
	Polished Plate	
	Regular	⅛", ¼"
	Parallel-O-Grey	¼"
	Heat Absorbing	⅛", ¼"
	Tuf-flex	¼"

*Picture glass cannot be used.

surface finishes

Sandblast finish is available, but details must be submitted for our approval and orders are subject to our acceptance. If approved, sandblast is applied to the air space surface only, either to one or both lights in order to provide cleanliness. Exterior sandblast will not be furnished. The sandblasting of glass reduces its strength 50%, and consequently we do not recommend *Thermopane* units with a sandblast surface.

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

Thermopane warranty

We make no warranty, express or implied, except that for a period of five (5) years from the date of manufacture we warrant that under normal conditions material obstruction of vision, resulting from film formation or dust collection between the interior glass surface of *Thermopane* will not occur.

This warranty will be void if *Thermopane* is not handled or installed in accordance with our instructions, or is damaged in handling or installation, or if the unit is subjected to stresses resulting from localized application of heat, which causes excessive temperature differentials over the glass surfaces or edges, or if strain is applied to the unit by movement of the building, or if provisions have not been made in accordance with sound practice for adequate expansion or contraction of framing members.

Our maximum liability under this warranty shall be the delivery of replacement lights of *Thermopane* to the railroad shipping point nearest the place of installation.

This warranty does not apply to such replacement lights beyond the original five-year period applying to the original unit; nor does it apply when *Thermopane* is used in ships or vehicles or is used outside continental United States.

No representative of ours has authority to change or modify this warranty in any respect.

shapes and pattern cut

Thermopane will be manufactured to straight edge patterns. Units can be produced with four or five sides but no angle can be less than 45° nor any one edge less than eight inches. Triangles cannot be furnished. The maximum sizes of pattern cut units must be within the limitations of the square and rectangular dimensions shown in columns three and four of the table on page 24. When both dimensions exceed 50″ the units will be manufactured with ½″ air space only.

Cutouts, notches, holes or finger pulls are not available. Bent shapes are not available. Circles are not available.

thermal shock

The room side light of a *Thermopane* unit may crack if excessive hot air is directed on to it from a hot air furnace register or an electric wall heater. This is true of single glass as well as *Thermopane*. Breakage may also occur if the glass is painted with signs, Christmas decorations, etc. Curtains, venetian blinds or heavy draperies hung too close to the room side light may act as a heat trap increasing temperatures in area covered and cause glass failure. Ventilation should be provided at the bottom, top and sides for air movement on the face of the glass.

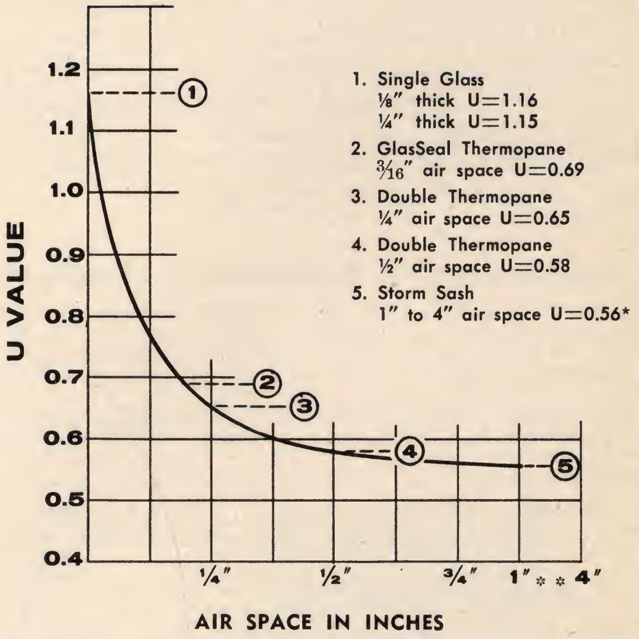
metal sash

Engineering practice dictates the need of sufficient columnar strength and for expansion joints in metal sash members. While the design and spacing of expansion joints should be the work of the architect, engineer or metal manufacturer, all metal details should be carefully checked when the job is taken off to determine if the sash has enough rabbet depth and height and is of sufficient strength to properly accept *Thermopane*.

heat transmission (U value)

Thermopane units provide a high resistance to heat flow, varying with the number of panes and the thickness of the air space used. Relation between heat lost by conduction and convection from single glazing and *Thermopane* is in direct proportion to their coefficients of heat transmission, disregarding the heat gain from the influx of solar energy.

variation of winter U value with air space thickness



*This value applies to storm sash with a sealed air space. Air leakage present in virtually all storm windows will, in effect, raise this value.

**There is no practical difference in the thermal resistance of air spaces between 1″ and 4″ thick.

U value—winter

Over-all heat transmission coefficient (U value) varies with ranges of temperature at which coefficient is determined. For most practical heat loss calculations coefficient U can be the value determined at 10° outside temperature, 70° inside temperature, 15 mph outside air velocity and natural convection inside. Therefore, the U values shown here apply to winter heat losses. (For U values which apply to summer heat gains for air conditioning, see page 16).

type	thickness	U-value		
single glass	⅛" ¼"	1.16 1.15		
double Thermopane single strength	⅛" or ¼"	3/16" air space* .69	¼" air space .65	½" air space .58
triple Thermopane	¼"	¼" air space .47		

*GlasSeal Thermopane only.

radiation

Thermopane windows can be made of different combinations of glass to provide a wide range of physical characteristics. The use of Heat Absorbing with standard plate glass reduces transmission of solar radiation.

A window double-glazed with clear flat glass transmits more daylight than an equal area of any other form of glass insulating unit. This is a distinct advantage on dark days. According to the table below, a *Thermopane* unit composed of two panes of ⅛" or ¼" thick clear glass transmits approximately 81% of daylight. Where reduction of glare is desired, *Thermopane* units made with a heat absorbing type of glass may be used to advantage.

calculation of light transmission

Light transmission of any combination of glasses can be obtained by multiplying their individual transmissions. Visible transmission for average daylight (illuminant C) of various types of glasses used in *Thermopane* combinations is given in the following table:

		per cent transmission		
	type of glass	ultra-violet	illuminant C	total radiation
	D.S.A. window glass	73.4	90.4	85.7
	sheet glass 3/16"	68.8	89.6	82.9
Libbey-Owens-Ford	polished plate			
	regular ⅛"	75.9	90.6	86.1
	regular or Tuf-flex ¼"	67.8	89.1	79.9
	parallel-o-grey ¼"	39.0	44.2	46.6
	heat absorbing ⅛"	58.8	83.1	63.2
	heat absorbing ¼" or Tuf-flex heat absorbing ¼"	44.9	74.7	46.3

source of values

All values are calculated assuming the sun's energy passes through an air mass of 2. This is generally accepted as average sun light. Illuminant C encompasses the wave lengths from 400 to 700 mmu. which is the visible portion of the sun's energy.

total radiation defined

Tables of infrared transmittance are not shown. Instead, the table of total radiation transmittance for solar energy is given for the following reasons: Since infrared energy is most frequently measured by the heat it produces, and since this kind of radiant energy was discovered through its heating effect, it has come to be generally assumed that only the infrared produces heat. This assumption is not correct. All radiant energy may be converted into heat if it is absorbed, and none of it is truly heat until after it has been absorbed and converted. There is more energy per wave in ultraviolet than in infrared and the visible also is more effective in producing heat than the infrared when it is absorbed. Solar energy is comprised of approximately 50% infrared and so it is not proper to compare the radiant energy transmitting properties of two glasses on the basis of their infrared transmittance alone.

condensation points

These charts show the combination of cold and warm side temperatures and warm side humidities at which condensation occurs where there is normal free air movement (natural convection), on the warm side and 15 mph outside air velocity.

Note that, at the same given inside and outside temperatures, *Thermopane* permits much higher inside relative humidity than possible with single glazing.

Condensation points on ⅛" glass may be considered same as ¼" glass since the table on page 15 shows that their warm side temperatures are substantially the same.

surface temperatures—warm side

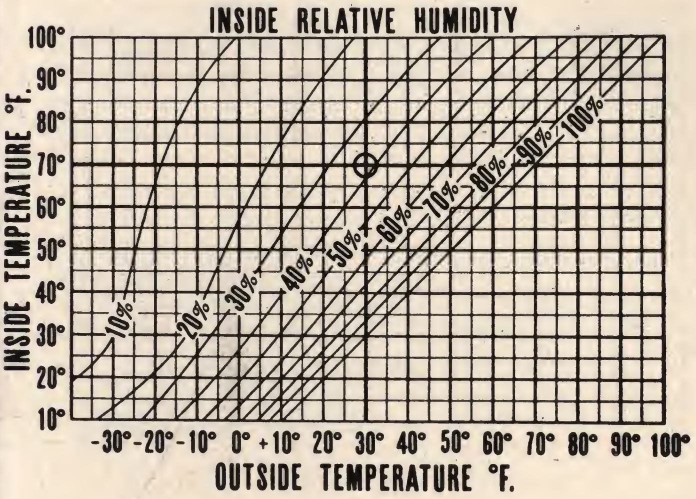
The warm side surface temperature of *Thermopane* is appreciably higher than that of single glazing. It has been usual to locate sources of heat near glass areas in buildings to offset both the conducted loss of heat from the room and the radiant loss from the bodies of persons near such cold glass areas.

The higher glass surface temperature of *Thermopane* greatly reduces the amount of heat that must be supplied near such areas, permitting greater flexibility in room design. Thus, the physical comfort of persons stationed near glass areas is greatly increased; greater room occupancy is achieved by placing working desks nearer window areas with a resultant saving of floor space.

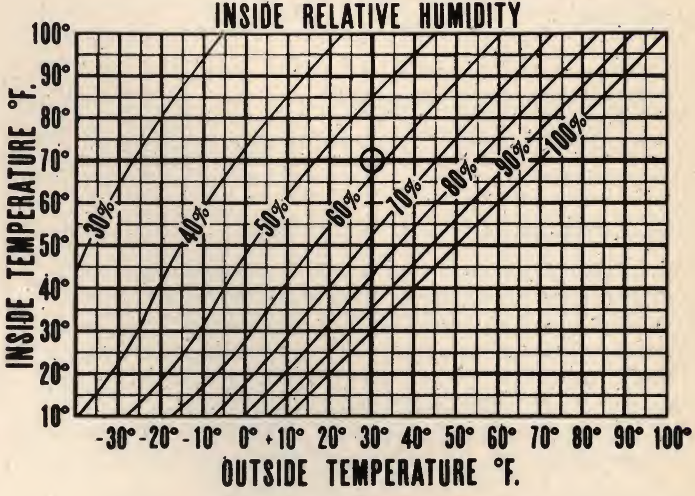
Thermopane permits a more healthful living condition and reduces the possibility of sash, sill, wall and floor deterioration by water drippage.

INSIDE SURFACE CONDENSATION POINTS AND INSIDE RELATIVE HUMIDITY (RH)

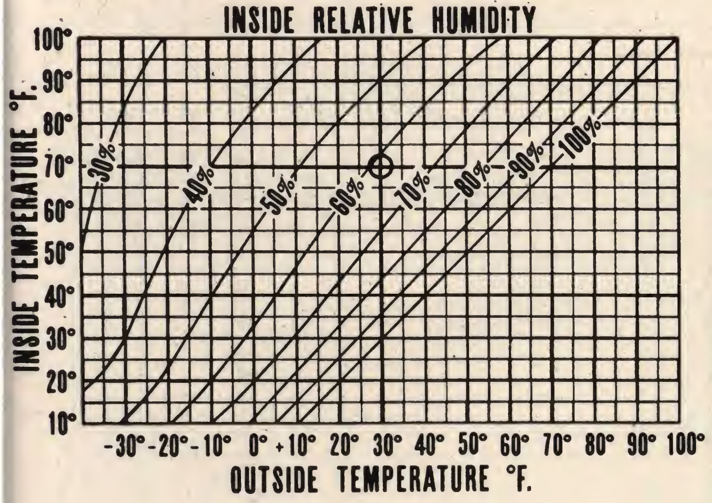
1/4″ polished plate



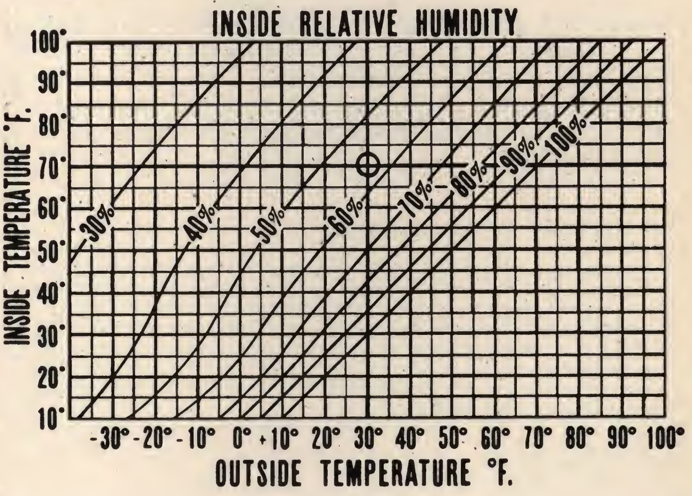
double *Thermopane* 1/4″ plate 1/4″ air space



double *Thermopane* 1/4″ plate 1/2″ air space



GlasSeal *Thermopane* 1/8″ sheet 3/16″ air space



temperatures of glass surface on warm side

and per cent relative humidity (RH) at which condensation occurs
(dry bulb air temperature 70° F. on warm side)

no. of panes	glass thickness	air space thickness	dry bulb air temperatures on cold side													
			−30°		−20°		−10°		0°		+10°		+20°		+30°	
			T	RH	T	RH	T	RH	T	RH	T	RH	T	RH	T	RH
single glass	⅛″	none	2°	5.5	9°	8.5	15°	12.0	22°	16.0	28°	21.0	35°	28.0	42°	36.5
	¼″	none	5°	6.0	11°	9.5	18°	13.0	24°	17.0	30°	22.5	37°	29.5	43°	37.5
double Thermopane	⅛″	¼″	35°	28.0	38°	31.5	41°	35.5	44°	39.5	47°	45.0	51°	50.0	54°	56.5
		½″	38°	31.0	41°	32.0	43°	38.0	46°	43.0	49°	48.0	52°	54.0	55°	60.0
	¼″	¼″	36°	28.5	39°	32.5	42°	36.5	45°	41.0	48°	47.0	51°	52.0	54°	58.0
		½″	39°	31.5	42°	33.0	45°	40.0	47°	45.0	50°	50.5	53°	56.0	56°	62.0
triple Thermopane	¼″	¼″	46°	41.5	48°	44.5	49°	49.0	52°	54.0	54°	58.0	57°	63.0	59°	68.5
GlasSeal Thermopane	⅛″	3⁄16″	34°	26.0	37°	29.5	40°	33.0	43°	37.0	46°	42.5	50°	49.0	53°	55.0

Above chart is based on normal convection currents on room side when unobstructed by curtains, draperies or heavy muntins. Condensation will occur at slightly higher inside temperatures than as shown on the charts if curtains, shades or the construction of the window prevent free air movement over the surface of the glass.

reduction of cooling load

Summer heat transmitted through glass is divided into three types or may be said to come from three sources:

(1) direct solar radiation

Where the window is exposed to direct sunshine.

(2) sky or diffuse radiation

In passing through the earth's atmosphere, much of the solar radiation is scattered, reflected and absorbed by dust particles, air molecules and water vapor. This relatively small percentage of direct solar radiation, called sky or diffuse radiation, will cause some heat transmission through a window even though it is not exposed directly to the sun.

(3) outdoor-indoor temperature differential

The air conditioning engineer usually bases his cooling calculations on a 20° F differential between outdoor and indoor temperatures. This difference means that part of the outdoor heat will be transmitted to the inside through a window by conduction and convection.

U value — summer

Summer air cooling calculations are usually based on an outside air temperature of 95° F. and exterior wind velocity of 7.5 mph, a room temperature of 75° F. U values for these summer conditions are given below. (For U values which apply to winter heat losses, see page 14).

type	glass thickness	U values		
single glass	⅛"	1.07		
	¼"	1.06		
double Thermopane	⅛" or ¼"	3/16" air-space* 0.64	¼" air space 0.61	½" air space 0.56
triple Thermopane	¼"	¼" air space 0.45		

*GlasSeal Thermopane only.

solar radiation transmission

When solar radiation strikes a glass surface, part is reflected, part absorbed and part transmitted. For diagrams which indicate graphically how heat and light transmittances vary with different single glazings and with various glass combinations in *Thermopane*, ask for L.O.F folder, form M-22.

Cooling loads for residences are calculated on a different basis than those for commercial buildings because residences are generally based on cooling 24 hours per day in contrast to commercial buildings where cooling is generally utilized only about 12 hours per day. In addition, there are other differences which contribute to the need for a different basis for the calculations.

cooling load calculations

residential buildings

The cooling load due to unshaded glass areas in residences is determined using the values in the table below and the glass area on each exposure. The total cooling load is simply the sum of the products of the heat gain per square foot times the glass area for each exposure.

example

Calculate the cooling load for a home located in Columbus, Ohio (40 deg. north latitude) and having the following areas of D.S.—D.S. *Thermopane;* north —100 sq. ft., east—50 sq. ft., south—300 sq. ft., and west—50 sq. ft.

exposure	sq. ft.	cooling load per sq. ft.	cooling load each exposure
north	100	14	1400
east	50	42	2100
south	300	27	8100
west	50	42	2100
total cooling load Btu per hour			13700

residential design cooling load due to windows*

north latitude	kind of glass	Btu per (hour) (square foot) north	east	south	west
30°	D.S. Sheet	20	49	23	49
	¼" Plate	20	47	22	47
	¼" H.A. Plate**	17	36	19	36
	D.S. —D.S. Thermopane	15	40	17	40
	¼" Pl.—¼" Pl. Thermopane	14	37	16	37
	H.A.**—Plate Thermopane	11	27	13	27
40°	D.S. Sheet	19	50	34	50
	¼" Plate	19	48	33	48
	¼" H.A. Plate**	16	37	26	37
	D.S.—D.S. Thermopane	14	42	27	42
	¼" Pl.—¼" Pl. Thermopane	14	38	25	38
	H.A.**—Plate Thermopane	11	28	18	28
50°	D.S. Sheet	20	53	42	53
	¼" Plate	19	50	40	50
	¼" H.A. Plate**	17	39	32	39
	D.S.—D.S. Thermopane	15	44	33	44
	¼" Pl.—¼" Pl. Thermopane	14	40	32	40
	H.A.**—Plate Thermopane	11	29	23	29

*Values based on data contained in the ASHAE Guide interpreted to conform with accepted methods of cooling-load predictions. Values for residential buildings are average heat gains for a design day. A design day is an average, clear August 1 with a maximum outdoor temperature of 95° F. An outdoor wind velocity of 7½ mph is assumed throughout.
**Heat gain values for Parallel-O-Grey plate are substantially the same as those for Heat Absorbing plate.

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

Cooling loads for residences are calculated on a different basis than those for commercial buildings because residences are generally based on cooling 24 hours per day in contrast to commercial buildings where cooling is generally utilized only about 12 hours per day. In addition, there are other differences which contribute to the need for a different basis for the calculations.

non-residential buildings

The portion of the cooling load due to glass in commercial, industrial, and public buildings is calculated using values in the table below. The method requires four sets of calculations, one or more of which may be eliminated by inspection. The necessary steps are as follows:

1. Determine the total cooling load for each exposure using values obtained from the table in the next column times the glass area involved.
2. For each exposure determine the combined glass area of the other three exposures and multiply this area by the value for a north exposure.
3. Add each value determined in step 1 to its corresponding value obtained in step 2. The largest of the four values obtained by this procedure is the design cooling load.

non-residential design cooling load due to windows*

north latitude	kind of glass	Btu per (hour) (square foot)			
		north	east	south	west
30°	D.S. Sheet	27	144	44	157
	¼" Plate	26	136	42	150
	¼" H.A. Plate**	21	97	34	112
	D.S.—D.S. Thermopane	21	125	36	133
	¼" Pl.—¼" Pl. Thermopane	19	115	32	124
	H.A.**—Plate Thermopane	15	78	25	88
40°	D.S. Sheet	27	144	78	157
	¼" Plate	26	136	75	150
	¼" H.A. Plate**	21	96	57	111
	D.S.—D.S. Thermopane	21	125	66	133
	¼" Pl.—¼" Pl. Thermopane	20	115	61	124
	H.A.**—Plate Thermopane	15	78	45	88
50°	D.S. Sheet	27	142	111	155
	¼" Plate	26	134	105	149
	¼" H.A. Plate **	21	96	80	111
	D.S.—D.S. Thermopane	21	123	93	131
	¼" Pl.—¼" Pl. Thermopane	19	113	87	122
	H.A.**—Plate Thermopane	16	77	63	87

*Values based on data contained in the ASHAE Guide interpreted to conform with accepted methods of cooling-load predictions. Values for non-residential buildings are 70 per cent of the maximum heat gains on a design day. A design day is an average, clear August 1 with a maximum outdoor temperature of 95° F. An outdoor wind velocity of 7½ mph is assumed throughout.

**Heat gain values for Parallel-O-Grey plate are substantially the same as those for Heat Absorbing plate.

example

Find the cooling load due to glass for an office building in Houston, Texas (30 deg. north latitude) glazed with the following areas of H.A.—Plate *Thermopane;* north—20,000 sq.ft., east—15,000 sq. ft., south—25,000 sq. ft. and west—10,000 sq. ft.

step 1

exposure	sq. ft.	cooling load per sq. ft.	cooling load each exposure
north	20,000	15	300,000
east	15,000	78	1,170,000
south	25,000	25	625,000
west	10,000	88	880,000

step 2

exposure	sq. ft. on all other exposures	cooling load per sq. ft.	cooling load for all other exposures
north	50,000	15	750,000
east	55,000	15	825,000
south	45,000	15	675,000
west	60,000	15	900,000

step 3

north— 300,000
750 000
1,050,000 Btu per hour

east— 1,170,000
825,000
1,995,000 Btu per hour

south— 625,000
675,000
1,300,000 Btu per hour

west— 880,000
900,000
1,780,000 Btu per hour

The total cooling load due to the glass would then be 1,995,000 Btu per hour

strength calculations

Thermopane should be calculated on the strength of the outboard glass with little, if any, allowance for the variable support from the inboard glass. Where extra strength is required to withstand high pressures which would rupture standard glasses, Thermopane can be made with Tuf-flex, a tempered plate glass. Tuf-flex, which is 3 to 5 times stronger than regular plate glass, is made by a special process of reheating and cooling clear plate glass. The tempering of glass in the Tuf-flex process increases the average modulus of rupture from 6,000 to 30,000 p.s.i.

In calculating the performance of Thermopane where unusual pressures exist, as in exterior glazing of high buildings to withstand high wind velocities, the pane on the pressure side may be examined for strength by the formula:

$$PA = 3.48\ Mt^2F$$

If the modulus of rupture (M) for standard glass is taken at 6000 pounds per square inch, this formula becomes:

$$P = \frac{20880\ t^2F}{AS}$$

P = the pressure in pounds per square foot
t = the thickness in inches
A = the area in square feet
F = the factor for ratio of width to height of pane
S = Safety factor (1 to 10)

ratio width-height	factor (F)	ratio width-height	factor (F)
10:10	1.000	5:10	1.25
9:10	1.005	4:10	1.45
8:10	1.02	3:10	1.8
7:10	1.07	2:10	2.6
6:10	1.14	1:10	5.0

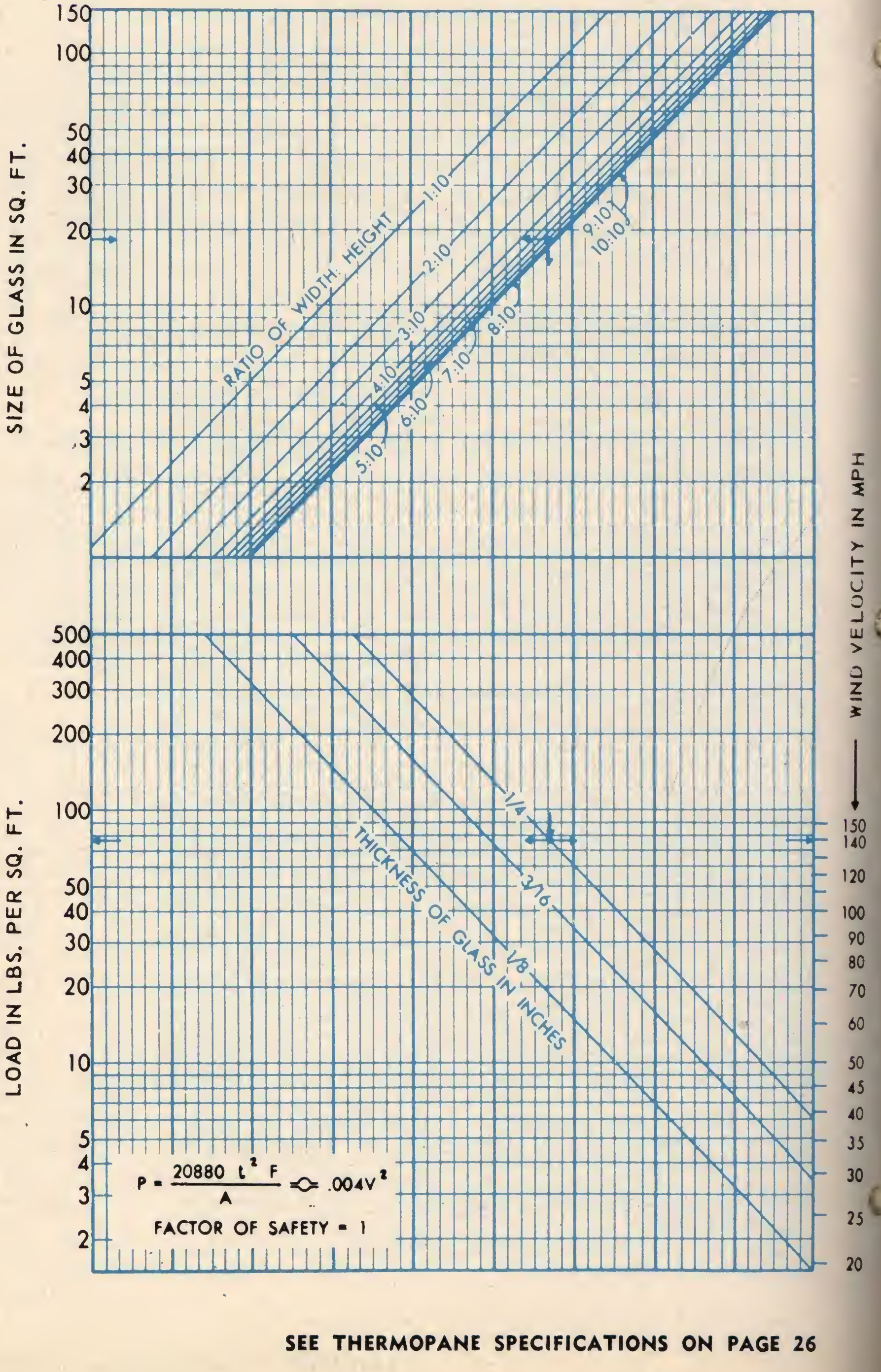
The wind velocities in miles per hour which are equivalent to given pressures in pounds per square foot may be found from the formula

$$\text{PRESSURE} = 0.004\ V^2$$

glass panes

A factor of safety of 1 has been included in chart opposite. Appropriate factor of safety to be used is a matter of engineering judgment governed by the individual application. If application involves a substantial hazard, safety factor of 5 to 10 is recommended. Decision should be made at discretion of the architect or engineer.

As an example of the use of the chart, suppose we wish to design a *Thermopane* panel of 17.5 square feet with a width to height ratio of 7:10 (5.0 feet wide, by 3.5 feet high). Read across the upper part of the chart from the 17.5 square foot size of glass to the diagonal line 7:10 for the ratio of width to height. At this intersection read down to the lower diagonal lines for the thickness of glass. The intersection with the diagonal line shows that a ¼″ thickness will stand 78 pounds per square foot on the left hand scale. Reading to the right from this intersection we find this is equivalent to 140 mph wind velocity.



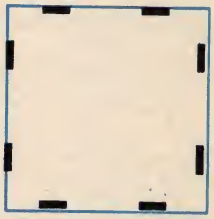
SEE THERMOPANE SPECIFICATIONS ON PAGE 26

glazing details

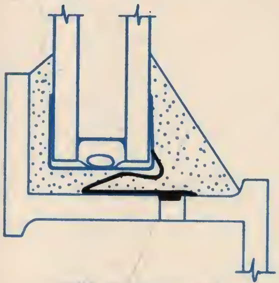
neoprene setting blocks and metal glazing clips

Neoprene setting blocks and spacer strips for ½″, ¾″, ⅞″, and 1″ thick units, and the metal glazing clips for ½″ units (as shown) must be used for the correct installation of *Thermopane* (available from L.O.F stock) if the L.O.F Warranty is to apply. Under no circumstances should units be forced into any type of sash.

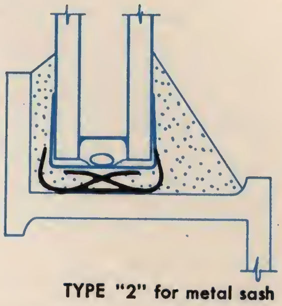
Glazing clips and Neoprene spacer strips shall be spaced evenly at sides and top, as illustrated.



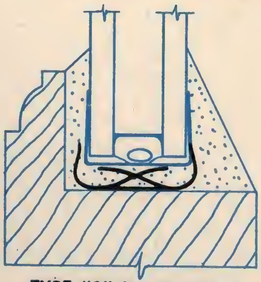
Setting blocks shall be installed one-quarter the distance in from the outer edge at the sill.



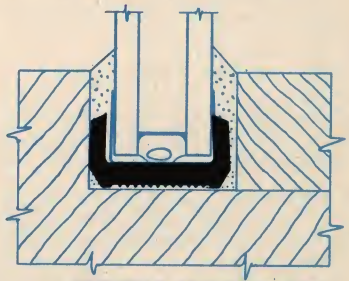
TYPE "1" for metal sash



TYPE "2" for metal sash



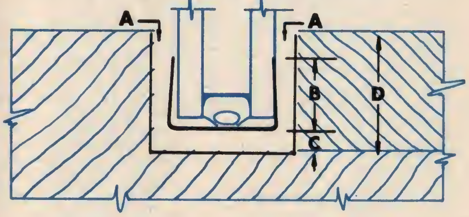
TYPE "3" for wood sash



NEOPRENE SETTING BLOCK

installation clearances and rabbet depths

Factory-fabricated, *Thermopane* dimensions cannot be changed at point of use. Adequate clearances and rabbet depths must be provided for all units so that metal seal is not visible.



	½″ AND ¾″ UNITS ⅛″ GLASS	⅝″ AND ⅞″ UNITS 3⁄16″ GLASS	¾″ AND 1″ UNITS ¼″ GLASS
(A) FACE CLEARANCE	⅛″	⅛″	⅛″
(B) METAL EDGE DEPTH	⅜″	⅜″	⅜″
(C) EDGE CLEARANCE	⅛″	¼″	¼″
(D) MINIMUM RABBET DEPTH	⅝″	¾″	¾″

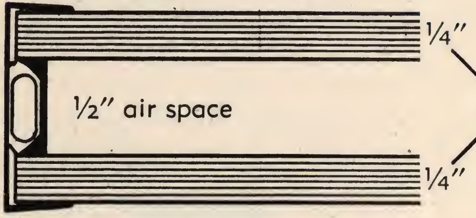
glazing information

Thermopane is a factory-sealed insulating glass unit which is subject to continuous movement due to the changes of temperature and barometric pressure. Adequate provision should be made for expansion and contraction of all metal glazing members—particularly long continuous expanses of metal members—to provide against any pressure on the glass. To insure against breakage or seal failure, a cushioning material such as glazing compound, Neoprene, or Vinyl, must be used so there is no contact between sash and glass at any point. Therefore, the warranty for *Thermopane* does not apply unless the glazing instructions furnished by Libbey-Owens-Ford are followed in every detail.

1. *Thermopane* must not be installed unless sash opening is square and plumb so that proper face and edge clearance can be maintained.
2. Face clearances between glass and stops must not be less than ⅛″
3. Edge clearances between glass and frame must not be less than ⅛″ on each edge for ½″ thick *Thermopane*, or ¼″ on each edge for units over ½″ thick.
4. Use a good knife-grade, non-hardening glazing compound, free from corrosive materials. DO NOT USE PUTTY and do not dilute or thin.
5. To insure uniform clearances use L-O-F Neoprene Setting Blocks and Spacers on all units set with face stops.
6. Use #1 or #2 L-O-F Metal Glazing Clips for ½″ thick *Thermopane* in sash without face stops.
7. Locate setting blocks or glazing clips on bottom of unit in from each corner a distance of one-fourth the width of the glass. Use spacer strips at sides and top of unit to insure uniform setting.
8. Use full bed of glazing compound on bottom of sash, enough at sides and top to make weather tight seal. If a void is left in the bottom rabbet, then weep holes should be provided for drainage of moisture to the exterior.
9. Trim and slope glazing compound from glass to outside stop for water drainage.
10. Do not nip corners or grind edges.
11. All units manufactured with *Thermopane* Heat Absorbing Glass must have Heat Absorbing Glass to outside only.
12. Total or partial covering of glass with paper and painted areas on glass (signs, etc.) should be avoided. Such coverings act as a heat trap and may cause glass failure due to increase of temperature of areas covered.

windows available for standard size Thermopane

2 panes of ¼″ polished plate
½″ air space

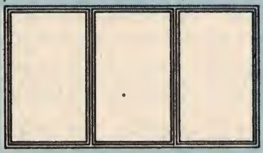


For a complete list of standard Thermopane sizes, see page 25.

This does not purport to be a complete list of manufacturers of sash for Thermopane. Neither does it show all the styles of sash made by the manufacturers listed. It is merely a guide in contacting your normal source of supply for Thermopane sash. Window openings will vary according to individual sash manufacturer's specifications. Therefore, manufacturers should be contacted for full information regarding their units.

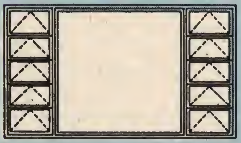
picture window

window wall

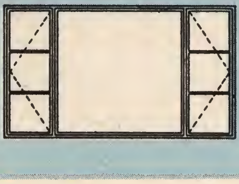


standard wood picture window units with flanking double hung sash

standard wood picture window units with flanking awnings



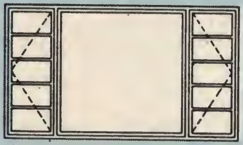
standard aluminum picture window units with flanking casements



Sash Manufacturer		Sash Opening		Glass Size	
		Width	Height	Width	Height
Any manufacturer shown on this page can provide picture window sash without flanking units				Use any size shown on this page	
Window walls can be constructed by using a series of picture window sash separated by mullions.		Glass sizes shown are for 8′ and 8½′ ceiling heights respectively, allowing 1′-6″ from floor to sill and 1′-0″ from head to ceiling.		42″	x 66″
				72½″	x 66″
				84″	x 66″
				96″	x 66″
				42″	x 72″
				84″	x 72″
				96″	x 72″
Andersen Corp. Bayport, Minn. Anderson Mfg. Co., Inc. Owensboro, Ky. Binswanger and Co., Inc. Richmond 21, Va. Caradco, Inc. Dubuque, Iowa Chicago & Riverdale Lumber Co. Chicago, Ill. Cole Mfg. Co. Memphis, Tenn. Curtis Companies, Inc. Clinton, Iowa Dealers Window Corp. Toledo, Ohio Farley & Loetscher Mfg. Co. Dubuque, Iowa Woodco, Inc. North Bergen, N. J. Hallack & Howard Lumber Co. Denver, Colo.	Edward Hines Lumber Co. Chicago 8, Ill. Huttig Mfg. Co. Muscatine, Iowa Huttig Sash & Door Co. St. Louis, Mo. Ideal Company Waco, Texas Malta Mfg. Co. Malta, Ohio Lumber Dealers, Inc. Denver 17, Colo. Radford Co. Oshkosh. Wis. R-Millwork Company Muscatine, Iowa Rock Island Millwork Rock Island, Ill. Weather-Seal, Inc. Barberton, Ohio Wisconsin Window Unit Co. Merrill. Wis.	3′-2³⁄₁₆″	x 11′-11¾″	36″	x 93″
		4′-4″	x 4′-2″	48½″	x 46″
		5′-0″	x 4′-2″	56½″	x 46⅛″
		5′-8″	x 4′-2″	64½″	x 46″
		6′-4″	x 4′-2″	72½″	x 46″
		4′-4″	x 4′-6″	48½″	x 50″
		5′-0″	x 4′-6″	56½″	x 50″
		5′-8″	x 4′-6″	64½″	x 50″
		6′-4″	x 4′-6″	72½″	x 50″
		7′-0″	x 4′-6″	80½″	x 50″
		8′-4″	x 4′-6″	96½″	x 50″
		3′-10⅝″	x 4′-6″	46⅛″	x 52½″
		4′-10⅝″	x 4′-6″	58⅛″	x 52½″
		5′-10⅝″	x 4′-6″	70⅛″	x 52½″
		4′-4″	x 5′-2″	48½″	x 58″
		5′-8″	x 5′-2″	64½″	x 58″
		6′-4″	x 5′-2″	72½″	x 58″
		7′-0″	x 5′-2″	80½″	x 58″
		8′-4″	x 5′-2″	96½″	x 58″
		10′-0″	x 5′-2″	116½″	x 58″
		5′-0″	x 5′-10″	56½″	x 66″
		5′-8″	x 5′-10″	64½″	x 66″
		6′-4″	x 5′-10″	72½″	x 66″
Dealers Window Corp. Toledo, Ohio Gate City Sash & Door Co. Fort Lauderdale, Fla.		Buck Opening			
		75⅛″	x 51″	72½″	x 46″
		67⅛″	x 51″	64½″	x 46″
		51⅛″	x 51″	48½″	x 46″
		72¾″	x 57″	70⅛″	x 52½″
		60¾″	x 57″	58⅛″	x 52½″
		48¾″	x 57″	46⅛″	x 52½″
		119⅛″	x 63″	116½″	x 58″
Reynolds Metals Co. Louisville 1, Ky. Ware Laboratories, Inc. Miami, Fla.		4′-5⅛″	x 4′-2⅝″	50⅜″	x 47¾″
		4′-5⅛″	x 5′-3″	50⅜″	x 60⅛″
		5′-9⅜″	x 4′-2⅝″	66⅝″	x 47¾″
		5′-9⅜″	x 5′-3″	66⅝″	x 60⅛″

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

standard wood picture window units with flanking casements



Sash Manufacturer	Sash Opening		Glass Size	
	Width	Height	Width	Height
	(Including Casements)			
Andersen Corp. Bayport, Minn. Only sizes marked# Brown-Graves Co. Akron, Ohio. For list of sizes contact manufacturer. Curtis Companies, Inc. Clinton, Iowa. For list of sizes, contact manufacturer. Dealers Window Corp. Toledo, Ohio Farley & Loetscher Mfg. Co. Dubuque, Iowa. Only sizes marked‡ Rolscreen Co. Pella, Iowa. Only sizes marked*. Rock Island Millwork Co. Rock Island, Ill. For list of sizes, contact manufacturer. Wisconsin Window Unit Co. Merrill, Wis. For list of sizes, contact manufacturer.	#6'-5¼"	3'-2 3/16"	#35½"	36"
	#8'-1"	3'-2 3/16"	#55¼"	36"
	#9'-8¾"	3'-2 3/16"	#75"	36"
	#6'-5¼"	4'-2⅜"	#35½"	48⅛"
	#8'-1"	4'-2⅜"	#55¼"	48⅛"
	#9'-8¾"	4'-2⅜"	#75"	48⅛"
	7'-½"	4'-5"	46⅛"	52½"
	8'-½"	4'-5"	58⅛"	52½"
	9'-½"	4'-5"	70⅛"	52½"
	#6'-5¼"	5'-2 9/16"	#35½"	60⅜"
	#8'-1"	5'-2 9/16"	#55¼"	60⅜"
	#9'-8¾"	5'-2 9/16"	#75"	60⅜"
	#3'-10¾"	3'-2 3/16"	#44½"	36"
	#5'-11"	5'-2 3/16"	#68¾"	36"
	#11'-11¾"	4'-2⅜"	#93"	48⅛"
	#3'-10¾"	4'-2⅜"	#44½"	48⅛"
	#5'-11"	4'-2⅜"	#68¾"	48⅛"
	#3'-10¾"	5'-2 9/16"	#44½"	60⅜"
	#5'-11"	5'-2 9/16"	#68¾"	60⅜"
	#11'-11¾"	5'-2 9/16"	#93"	60⅜"
	*4'-3"	4'-4"	*48"	48"
	*6'-3"	4'-4"	*72"	48"
	*4'-3"	5'-4"	*48"	60"
	*6'-3"	5'-4"	*72"	60"
	‡6'-4"	5'-10"	‡72½"	66"

aluminum sash picture window units

Sash Manufacturer	Sash Opening		Glass Size	
	Width	Height	Width	Height
General Bronze Corp. Garden City, L. I. Contact manufacturer for additional sizes of sash for non-standard Thermopane.	4'-0"	4'-8"	46⅛"	52½"
	5'-0"	4'-8"	58⅛"	52½"
	6'-0"	4'-8"	70⅛"	52½"
	4'-0"	5'-0"	46⅛"	56½"
	5'-0"	5'-0"	58⅛"	56½"
	6'-0"	5'-0"	70⅛"	56½"

standard aluminum picture window units with flanking double hung sash

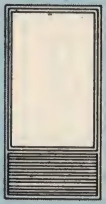
Sash Manufacturer	Sash Opening		Glass Size	
	Width	Height	Width	Height
Adams & Westlake* Elkhart, Ind. Cupples Products Co. Maplewood, St. Louis 17, Mo. Fleet of America Buffalo 2, N. Y. General Bronze Corp. Alwintite Div.* Garden City, L. I. Ceco Steel Products Corp. Sterling Aluminum Window Div., New York 17, N. Y.	3'-2"	4'-2"	35½"	48⅛"
	4'-4"	4'-6"	48½"	50"
	5'-0"	4'-6"	56½"	50"
	5'-8"	4'-6"	64½"	50"
	6'-4"	4'-6"	72½"	50"
	7'-0"	4'-6"	80½"	50"
	5'-8"	5'-2"	64½"	58"
	6'-4"	5'-2"	72½"	58"
	7'-0"	5'-2"	80½"	58"

*Indicates these firms manufacture to order.

residential steel sash picture window units

Sash Manufacturer	Sash Opening		Glass Size	
	Width	Height	Width	Height
Wm. Bayley Co. Springfield, Ohio Bliss Steel Products Co. E. Syracuse, N. Y. Ceco Steel Products Co. Chicago 50, Ill. Fenestra, Inc. Detroit 11, Mich. Michael Flynn Mfg. Co. Philadelphia 24, Pa. Hopes' Windows, Inc. Jamestown, N. Y. Mesker Bros. St. Louis, Mo. J. S. Thorn Co. Philadelphia 32, Pa. Truscon Steel Co. Youngstown, Ohio	4'-5⅛"	4'-2⅝"	50⅜"	47¾"
	4'-5⅛"	5'-3"	50⅜"	60⅛"
	5'-9⅜"	4'-2⅝"	66⅝"	47¾"
	5'-9⅜"	5'-3"	66⅝"	60⅛"

standard wood picture window units with louvres

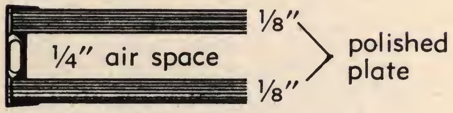


Sash Manufacturer	Sash Opening		Glass Size	
	Width	Height	Width	Height
Wisconsin Window Unit Co. Merrill, Wis.	39⅜"	53¾"	35½"	36"
	39⅜"	65¾"	35½"	48⅛"
	39⅜"	77¾"	35½"	60⅜"
	49⅞"	65¾"	46"	48½"
	49⅞"	74¾"	46⅛"	56½"
	49⅞"	89¾"	46"	72½"

windows available for standard size Thermopane

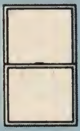
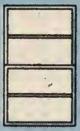
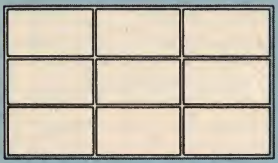
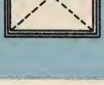
★★ 2 panes of ⅛″ polished plate or DSA window glass

¼″ air space

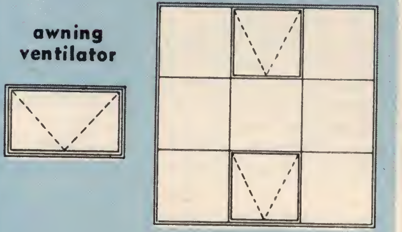
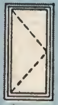
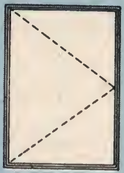
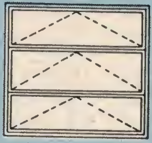
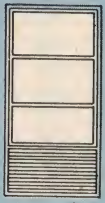
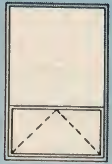
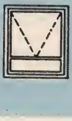


For a complete list of standard Thermopane sizes, see page 25.

This does not purport to be a complete list of manufacturers of sash for Thermopane. Neither does it show all the styles of sash made by the manufacturers listed. It is merely a guide in contacting your normal source of supply for Thermopane sash. Window openings will vary according to individual sash manufacturer's specifications. Therefore, manufacturers should be contacted for full information regarding their units.

	Sash Manufacturer		Sash Opening Width Height	Glass Size Width Height
double hung wood windows (2-light) 	Binswanger Co., Inc. Richmond 21, Va. Chicago & Riverdale Lumber Co. Chicago, Ill. Dekker-Brish Millwork Co. 148th & Indiana Dolton, Illinois Woodco, Inc. North Bergen, N. J. Ed. Hines Lumber Co. Chicago 8, Ill. Olson Millwork Company Cedar Rapids, Iowa		2′-0″ x 4′-2″ 2′-4″ x 4′-2″ 2′-4″ x 4′-6″ 2′-8″ x 4′-6″ 3′-0″ x 4′-6″ 3′-4″ x 4′-6″ 3′-8″ x 4′-6″ 4′-0″ x 4′-6″ 2′-4″ x 5′-2″ 2′-8″ x 5′-2″ 3′-0″ x 5′-2″ 3′-4″ x 5′-2″ 3′-8″ x 5′-2″ 4′-0″ x 5′-2″	20″ x 22″ 24″ x 22″ 24″ x 24″ 28″ x 24″ 32″ x 24″ 36″ x 24″ 40″ x 24″ 44″ x 24″ 24″ x 28″ 28″ x 28″ 32″ x 28″ 36″ x 28″ 40″ x 28″ 44″ x 28″
double hung wood windows (4-light) 	Binswanger Co., Inc. Richmond 21, Va. Chicago & Riverdale Lumber Co. Chicago, Ill. Dekker-Brish Millwork Co. 148th & Indiana Dolton, Illinois Woodco, Inc. North Bergen, N. J. Ed. Hines Lumber Co. Chicago 8, Ill. Olson Millwork Company Cedar Rapids, Iowa		2′-0″ x 4′-2″ 2′-4″ x 4′-2″ 2′-4″ x 4′-6″ 2′-8″ x 4′-6″ 3′-0″ x 4′-6″ 3′-4″ x 4′-6″ 3′-8″ x 4′-6″ 4′-0″ x 4′-6″ 2′-4″ x 5′-2″ 2′-8″ x 5′-2″ 3′-0″ x 5′-2″ 3′-4″ x 5′-2″ 3′-8″ x 5′-2″ 4′-0″ x 5′-2″	20″ x 10⅝″ 24″ x 10⅝″ 24″ x 11⅝″ 28″ x 11⅝″ 32″ x 11⅝″ 36″ x 11⅝″ 40″ x 11⅝″ 44″ x 11⅝″ 24″ x 13⅝″ 28″ x 13⅝″ 32″ x 13⅝″ 36″ x 13⅝″ 40″ x 13⅝″ 44″ x 13⅝″
panel window system (wood) 	Builders Products, Inc. Cleveland, Ohio Blount Lumber Co. Lacona, N. Y. Chicago & Riverdale Lumber Co. Chicago, Ill. Curtis Companies, Inc. Clinton, Iowa Curtis Companies, Inc. Lincoln, Nebr. Curtis Companies, Inc. Topeka, Kansas Curtis Companies, Inc. Chicago, Ill. Curtis Companies, Inc. Wausau, Wis. Curtis Companies, Inc. Minneapolis, Minn. Dyke Bros. Little Rock, Ark. Fabrow Mfg. Co. Toledo 9, Ohio Fred Reuten, Inc. Closter, N. J.	Goshen Sash & Door Co. Goshen, Ind. Lubbock Sash & Door Co. Lubbock, Texas Ohio Plate Glass Co. Toledo 4, Ohio Pease Woodwork Co. Cincinnati 23, Ohio Lumber Dealers, Inc. Denver 17, Colo. Randall Bros. Atlanta, Ga. Royal Glass Works Long Island City, N. Y. Rust Sash & Door Co. Kansas City, Mo. Universal Window Co. Atlanta, Ga. Universal Window Co. Charlotte, N. C. Wadsworth Millwork Co. Wadsworth, Ohio Wisconsin Window Unit Co. Merrill, Wis. Work-Millwork Monterey, Calif.	45¾″ x 25¾″ 36¼″ x 24¼″	45½″ x 25½″ 36″ x 24″
ventilator for panel window system 	WOOD All manufacturers of the wood panel window system manufacture wood ventilators. ALUMINUM A B C Steel Equipment Co. New York 10, N. Y. Duralite Window Corp. Knoxville, Tenn. Marmet Corp. Wausau, Wis.	Superior Window Company Miami, Fla. Ware Laboratories, Inc. Miami, Fla.	45¾″ x 25¾″ 33¼″ x 21¼″	42½″ x 22½″ 33″ x 21″

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

	Sash Manufacturer		Sash Opening Width Height	Glass Size Width Height
panel wall (9-light)  awning ventilator	STEEL Fenestra, Inc.* Detroit, Mich. ALUMINUM Duralite Window Corp. Knoxville, Tenn. Marmet Corp. Wausau, Wis. *Fenestra, Inc. manufactures a non-standard size ventilating unit	Truscon Steel Co. Youngstown, Ohio Superior Window Company Miami, Fla. Ware Laboratories, Inc. Miami, Fla.		36″ x 24″ 34¹¹⁄₁₆″ x 22¹¹⁄₁₆″
wood casements 	Dealers Window Corp. Toledo, Ohio Rolscreen Co. Pella, Iowa		23″ x 40″ 23″ x 52″ 23″ x 64″ 27″ x 28″ 24″ x 36″ 27″ x 36″ 27″ x 40″ 27″ x 52″	20″ x 36″ 20″ x 48″ 20″ x 60″ 24″ x 24″ 21″ x 33″ 24″ x 32″ 24″ x 36″ 24″ x 48″
residential steel casements (without muntins) 	Bliss Steel Products Co. E. Syracuse, N. Y. Druwhit Metal Products Co. Los Angeles 11, Cal. Michael Flynn Mfg. Co. Philadelphia 24, Pa.	Hopes' Windows, Inc. Jamestown, N. Y. Soule Steel Co. San Francisco 24, Cal. Truscon Steel Co. Youngstown, Ohio	For detailed information about omitting muntins contact any L-O-F district office.	T-1 15¹⁵⁄₁₆″ x 35³⁄₁₆″ T-2 15⅞″ x 36⁷⁄₁₆″ T-3 15¹⁵⁄₁₆″ x 47½″ T-4 15¹⁵⁄₁₆″ x 48¾″ T-5 17³⁄₁₆″ x 36⁷⁄₁₆″ T-6 17³⁄₁₆″ x 48¾″
wood awning windows 	Curtis Companies, Inc. Clinton, Iowa Gate City Sash & Door Co. Ft. Lauderdale, Fla. Woodco, Inc. North Bergen, N. J.	Ludman Corporation Miami, Fla. Metz Mfg. Co. Dubuque, Iowa R-M Millwork Company Muscatine, Iowa		20″ x 16″ 32″ x 16″ 44″ x 16″ 28″ x 18″ 36″ x 18″ 44″ x 18″
panel window with louvres 	Wisconsin Window Unit Co. Merrill, Wis.		49⅜″ x 104″	45½″ x 25½″
modified panel window (wood) 	Dealers Window Corp. Toledo, Ohio Fabrow Mfg. Co. Toledo 9, Ohio Fred Reuten, Inc. Closter, N. J. Wadsworth Millwork Co. Wadsworth, Ohio			45⅜″ x 52″ ★★Manufactured only with 2 lights of ¼″ Plate and ½″ Air Space; or 2 lights of ³⁄₁₆″ Sheet and ½″ Air Space.
farm service buildings 	These ⅞″-thick Thermopane units for farm buildings are made with ³⁄₁₆″ sheet glass only and ½″ air space only. They are stenciled for use in farm buildings.			½″ Air Space and ³⁄₁₆″ Sheet Glass only 36″ x 44″ 36″ x 60″ 44″ x 72″
	These ½″-thick units for farm buildings are made with double strength A-quality window glass only and ¼″ air space.		Studs 24″ on center for fixed windows with stops nailed to studs.	Five Sizes Below ¼″ Air Space and DSA Glass only 22″ x 28″ 22″ x 36″
 	Steel sash manufactured by Clay Equipment Corp., Cedar Falls, Iowa. Thermopane units ½″-thick made only with double strength A-quality window glass only and ¼″ air space.		32″ x 36″ 32″ x 36″	31½″ x 35½″ 30¼″ x 22″ [Top] Tilting 31½″ x 11⅜″ [Bottom] Fixed

dimensional data

*For building exteriors, all *Thermopane* units with either dimension 50" or less can be manufactured with either ¼" or ½" air space. If both dimensions exceed 50" the units will be manufactured with ½" air spaces only. NOTE carefully max. size limitations because the total sq. ins. govern the max. widths and heights i.e., when a double Thermopane unit is manufactured of Polished Plate ¼" and ½" air space and the size is 68" in one dimension, then the other dimension cannot be over 144" to be within the 10,000 sq. in. max. This would hold true on units 82" x 120" or 100" x 100". A unit 100" x 144" could not be furnished as it totals 14,400 sq. in. Thermopane likely to be subjected to pressures encountered at elevations in excess of 4000 ft. should have a ¼" air space if the shorter dimension is between 8" and 16".

type of glass	min. size ¼" or ½" air space	maximum size with ¼" air space	maximum size with ½" air space	thickness range		dimensional tolerance	approx. net. wt. per sq. ft.
				¼" air space	½" air space		
D.S.A. (window glass) ⅛" Polished Plate ⅛" Heat Absorbing Plate	8" x 8"	short dim. 8" to 48" max. long dim. 76" within a maximum total area of 2300 square inches *see footnote	short dim. 8" to 48" max. long dim. 76" within a maximum total area of 2300 square inches *see footnote	17/32" ±1/32"	27/32" ±1/32"	8" to 36" high to 48" wide inc. ±1/16" over 48" to 76" wide +⅛" −1/16"	3¼ lbs.
3/16" A Sheet (window glass)	8" x 8"	short dim. 8" to 50" max. long dim. 78"	short dim. 8" to 50" max. long dim. 78"	23/32" ±1/32"	31/32" ±1/32"	8" to 36" high to 48" wide incl. +⅛" −1/16" over 36" to 100" high over 48" to 132" wide +3/16" −1/16"	5 lbs.
¼" Polished Plate (regular)	8" x 8"	short dim. 8" to 16" inc. max. long dim. 100" short dim. over 16" to 50" inc. max. long dim. 144"	short dim. 8" to 16" inc. max. long dim. 100" short dim. over 16" to 100" max. long dim. 144" within a maximum total area of 10,000 square inches *see footnote	27/32" ±1/32"	1 3/32" ±1/32"		6½ lbs.
¼" Heat Absorbing Plate ¼" Parallel-O-Grey Plate	8" x 8"	short dim. 8" to 16" inc. max. long dim. 100" short dim. over 16" to 48" inc. max. long dim. 120"	short dim. 8" to 16" inc. max. long dim. 100" short dim. over 16" to 84" max. long dim. 120" within a maximum total area of 7200 square inches *see footnote	27/32" ±1/32"	1 3/32" ±1/32"		6½ lbs.
¼" Tuf-flex Polished Plate ¼" Tuf-flex Heat Absorbing ¼" Tuf-flex Parallel-O-Grey	8" x 8"	40" x 48"	40" x 48"	27/32" ±1/32"	1 3/32" ±1/32"		6½ lbs.

sliding door—standard sizes

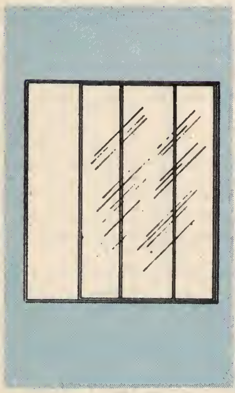
¼" polished plate with ½" air space—1" thick

33" x 76¾" 45" x 76¾" 57" x 76¾"

3/16" A sheet with ¼" air space—⅝" thick

33" x 76¾" 34" x 76" 45" x 76¾" 46" x 76"

aluminum



Adams Engineering Co., Inc.
19300 Biscayne Blvd.
Miami, Florida
Ador Sales, Inc.
2345 Commonwealth Ave.
Fullerton, Calif.
The Alumiline Corp.
Donnell Lane
Pawtucket, R. I.
V. E. Anderson Mfg. Company, Inc.
Owensboro, Kentucky
Arcadia Metal Products
801 South Acacia Ave.
Fullerton, Calif.
Bailey-Kelleher Company
500 Bellevue Ave.
Detroit 7, Michigan
Binswanger Gulfspray Sliding Door Co.
207 North Main St.
Houston 1, Texas
Bur-Val Mfg. & Metal Supply Co.
Burbank, Calif.
Capitol Products
Mechanicsburg, Penna.
Daryl Products
7240 N. E. 4th Ave.
Miami, Florida
Fenestra, Inc.
2250 East Grand Blvd.
Detroit 11, Michigan
Fleet of America, Inc.
515 New Walden Ave.
Buffalo 25, N. Y.
General Bronze Corp.
Alwintite Division
Garden City, N. Y.
Glamour Sliding Door Corp.
4723 N. Pulaski Road
Chicago 30, Illinois
Glide Windows, Inc.
7463 Varna Avenue
N. Hollywood, Calif.
Hi-View Products, Inc.
3150 E. 11th Ave.
Hialeah, Fla.
Hollyview Sliding Door & Window Co.
13060 Saticoy Street
N. Hollywood, Calif.
Lynart, Inc.
2320 Centinela Avenue
W. Los Angeles, Calif.
Malibu Manufacturing Co.
P. O. Box 413
El Monte, Calif.
Mayfair Industries, Inc.
Lafayette, Louisiana
Frank B. Miller Mfg. Co., Inc.
3216 Valhalla Drive
Burbank, Calif.
The Modern Shower Door Co.
1804 E. 40th St.
Cleveland, Ohio
Nudor Mfg. Corporation
7326 Fulton Avenue
N. Hollywood, Calif.
Oro Manufacturing Co.
1425 E. Michigan Street
Adrian, Michigan
Pacific Fullview Co.
4640 Sperry St.
Los Angeles, Calif.
Shower Door Co. of America
1 Permalume Place
Atlanta, Ga.
Slide-View Door & Window Co.
P. O. Box 409
El Monte, Calif.
Sun Valley Sliding Door Co.
8354 San Fernando Road
Sun Valley, Calif.
Trimview Metal Products
600 North 3rd Street
Covina, Calif.
Viewall, Inc.
7601 Arvilla Ave.
Burbank, Calif.
T. V. Walker & Son, Inc.
P. O. Box 547
217 North Lake
Burbank, Calif.

steel

Arcadia Metal Products
801 South Acacia Ave.
Fullerton, Calif.
Malibu Mfg. Co.
P. O. Box 413
El Monte, Calif.
Michel & Pfeffer Iron Works, Inc.
212 Shaw Road
So. San Francisco, Calif.
Frank B. Miller Mfg. Co., Inc.
3216 Valhalla Drive
Burbank, Calif.
Slide-View Door & Window Co.
P. O. Box 409
El Monte, Calif.
Steelbilt, Inc.
18001 South Fiqueroa
Gardenia, Calif.

SEE THERMOPANE SPECIFICATIONS ON PAGE 26

standard sizes

Bondermetic

2 panes of ¼″ polished plate ½″ air space

Width		Height
33″	x	76¾″
35½″	x	36″
35½″	x	48⅛″
35½″	x	60⅜″
44½″	x	36″
55¼″	x	36″
68¾″	x	36″
75″	x	36″
93″	x	36″
42″	x	66″
42″	x	72″
44½″	x	48⅛″
44½″	x	60⅜″
45″	x	76¾″
45⅜″	x	52″
48½″	x	46″
64½″	x	46″
72½″	x	46″
46⅛″	x	52½″
56½″	x	46⅛″
47¾″	x	50⅜″
66⅝″	x	47¾″
48″	x	48″
48″	x	60″
72″	x	48″
55¼″	x	48⅛″
68¾″	x	48⅛″
75″	x	48⅛″
93″	x	48⅛″
48½″	x	50″
48½″	x	58″
56½″	x	50″
64½″	x	50″
72½″	x	50″
80½″	x	50″
96½″	x	50″
50⅜″	x	60⅛″
58⅛″	x	52½″
70⅛″	x	52½″
55¼″	x	60⅜″
56½″	x	58⅛″
56½″	x	66″
70⅛″	x	56½″
57″	x	76¾″
64½″	x	58″
72½″	x	58″
80½″	x	58″
96½″	x	58″
116½″	x	58″
72″	x	60″
66⅝″	x	60⅛″
68¾″	x	60⅜″
75″	x	60⅜″
93″	x	60⅜″
64½″	x	66″
72½″	x	66″
84″	x	66″
96″	x	66″
84″	x	72″
96″	x	72″

2 panes of ⅛″ polished plate or DSA window glass ¼″ air space

Width		Height
15 15/16″	x	35 3/16″
15⅞″	x	36 7/16″
15 15/16″	x	47½″
15 15/16″	x	48¾″
17 3/16″	x	36 7/16″
17 3/16″	x	48¾″
20″	x	10⅝″
20″	x	16″
20″	x	22″
20″	x	36″
20″	x	48″
20″	x	60″
24″	x	10⅝″
24″	x	11⅝″
24″	x	13⅝″
24″	x	22″
24″	x	24″
*24″	x	28″
*24″	x	32″
*24″	x	36″
24″	x	48″
28″	x	11⅝″
28″	x	13⅝″
28″	x	18″
*28″	x	24″
28″	x	28″
32″	x	11⅝″
32″	x	13⅝″
32″	x	16″
*32″	x	24″
32″	x	28″
33″	x	21″
34 11/16″	x	22 11/16″
36″	x	11⅝″
36″	x	13⅝″
36″	x	18″
*36″	x	24″
36″	x	28″
40″	x	11⅝″
40″	x	13⅝″
40″	x	24″
40″	x	28″
42½″	x	22½″
44″	x	11⅝″
44″	x	13⅝″
44″	x	16″
44″	x	18″
44″	x	24″
44″	x	28″
45½″	x	25½″

*Considered Standard Size even though width and height dimensions, as listed are reversed.

GlasSeal

DSA sheet glass with 3/16″ air space (thickness .450″±.050″)

Width		Height
16″	x	24″
16″	x	32″
16″	x	36″
16″	x	48″
16″	x	60″
16 9/16″	x	24⅝″
16 9/16″	x	30 13/16″
16 9/16″	x	36 13/16″
16 9/16″	x	49″
16 9/16″	x	61 3/16″
19″	x	15″
20″	x	24″
20″	x	32″
20″	x	36″
20″	x	48″
20″	x	60″
21 1/16″	x	24⅝″
21 1/16″	x	30 13/16″
21 1/16″	x	36 13/16″
21 1/16″	x	49″
21 1/16″	x	61 3/16″
22″	x	18″
22″	x	55 9/16″
24″	x	24″
24″	x	32″
24″	x	36″
24″	x	48″
24″	x	60″
24¼″	x	15¼″
27¼″	x	14¼″
27¼″	x	18¼″
27¼″	x	22¼″
27¼″	x	30¼″
28″	x	14″
28″	x	18″
28″	x	22″
32″	x	16″
34 11/16″	x	22 11/16″
36″	x	14″
36″	x	18″
36″	x	22″
36″	x	24″
36″	x	30″
36⅝″	x	14¼″
36⅝″	x	18¼″
36⅝″	x	22¼″
36⅝″	x	30¼″
39″	x	14″
39″	x	18″
39″	x	22″
39″	x	30″
39⅝″	x	14¼″
39⅝″	x	18¼″
39⅝″	x	22¼″
39⅝″	x	30¼″
42½″	x	22½″
44″	x	14″
44″	x	18″
44″	x	22″
44″	x	30″
44⅝″	x	14¼″
44⅝″	x	18¼″
44⅝″	x	22¼″
44⅝″	x	30¼″
45½″	x	25½″

SSA sheet glass with 3/16″ air space (thickness .375″±.050″)

Width		Height
20″	x	14″
20″	x	16″
20″	x	20″
24″	x	14″
24″	x	16″
24″	x	20″
24″	x	24″
24″	x	28″
28″	x	14″
28″	x	16″
28″	x	20″
28″	x	24″
28″	x	28″
32″	x	14″
32″	x	16″
32″	x	20″
32″	x	24″
32″	x	28″
36″	x	14″
36″	x	16″
36″	x	20″
36″	x	24″
36″	x	28″
40″	x	14″
40″	x	16″
40″	x	20″
40″	x	24″
40″	x	28″

For information regarding special sizes, see page 12.

The Thermopane monogram will be in the lower right-hand corner and should be glazed in this position whenever possible. Thermopane made with window glass should not be turned when set. Specify width first.

SUGGESTED SPECIFICATIONS—LIBBEY • OWENS • FORD PRODUCTS

POLISHED PLATE GLASS

Plate glass shall be Libbey-Owens-Ford *Parallel-O-Plate* Glass and shall be (__________) thick and (________) quality as defined by Federal Specification DD-G-451a.

HEAVY POLISHED PLATE GLASS

Heavy polished plate glass (in thicknesses from ⅜″ through ¾″) shall be twin ground (________) thick. One inch thickness shall be conventionally ground. Quality of heavy plate shall be as defined in Federal Specification DD-G-451a.

¼″ PARALLEL-O-GREY POLISHED PLATE GLASS

Where neutral grey polished plate glass is shown on the drawings, it shall be Libbey-Owens-Ford ¼″ glazing quality Parallel-O-Grey and shall meet the heat absorbing requirements of Federal Specification DD-G-451a.

HEAT ABSORBING POLISHED PLATE GLASS

Where heat absorbing plate glass is shown on the drawings, it shall be Libbey-Owens-Ford Heat Absorbing Polished Plate Glass, ¼″ thick glazing quality as defined by Federal Specification DD-G-451a.

21/64″ ROUGH PLATE BLANKS (OBSCURE GLASS)

Where Rough Plate Blanks are shown on the drawings they shall be Libbey-Owens-Ford 21/64″ (regular or heat absorbing) Rough Plate Blanks.

WINDOW GLASS—SHEET GLASS

All window or sheet glass shall be Libbey-Owens-Ford Flat Drawn (_______) thick and (_______) quality as defined by Federal Specification DD-G-451a. Each light shall bear the identifying L-O-F label.

MIRRORS

Mirrors shall be made of Libbey-Owens-Ford ¼″ *Parallel-O-Plate* Glass and shall be of (__________) quality as defined by Federal Specification DD-G-451a, in sizes as shown on drawings.

MIRROPANE TRANSPARENT MIRRORS

Transparent mirrors shall be *Mirropane*, made of Libbey-Owens-Ford (⅛″ or ¼″) thick Polished Plate Glass as defined by Federal Specification DD-G-451a. It is also available in ¼″ Parallel-O-Grey polished plate glass. Sizes shall be shown on drawings and installation shall be according to manufacturer's recommendations.

TUF-FLEX TEMPERED PLATE GLASS

Where tempered glass is shown on the drawings, it shall be Libbey-Owens-Ford *Tuf-flex* Polished Plate Glass (________) thick and (________) type of glass in sizes as shown on drawings. The quality of this glass shall meet the requirements of Federal Specification DD-G-451a.

TUF-FLEX TEMPERED PLATE GLASS DOORS

All glass doors shall be Tempered Plate Glass (½″ or ¾″ thick) in sizes as shown on the drawings, equipped with fittings of (solid bronze, aluminum or stainless steel) and with (polished bronze, brushed bronze, polished chrome, brushed chrome, alumilited aluminum or gold anodized) finish as manufactured by Libbey-Owens-Ford Glass Company and installed according to manufacturer's instructions. The quality of this glass shall meet the requirements of Federal Specification DD-G-451a.

THERMOPANE INSULATING GLASS

Bondermetic (metal-to-glass) Seal

All insulating glass shall be double *Thermopane* in sizes indicated on the drawings and composed of an inner pane of (__________) glass (__________) thick and an outer pane of (_________) glass (_________) thick, hermetically sealed with a metal-to-glass bond* and separated by a (¼″ or ½″) dehydrated air space as manufactured by Libbey-Owens-Ford Glass Company and installed according to manufacturer's instructions. The quality of this glass shall meet the requirements of Federal Specification DD-G-451a.

*Also furnished in GlasSeal Thermopane with 3/16″ air space.

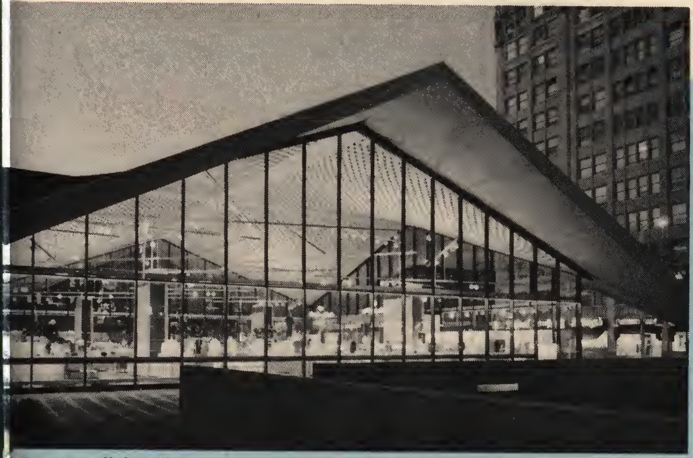
GlasSeal

All insulating glass herein shall be GlasSeal Thermopane composed of the two lights Double (Single) Strength A quality sheet glass separated by a 3/16″ air space.

VITROLUX SPANDREL GLASS

All opaque plate glass specified herein or indicated on plans for use as spandrels or curtain walls shall be *Vitrolux* as manufactured by Libbey-Owens-Ford Glass Company, and shall consist of ¼″ heat-strengthened plate glass with vitrous color fire-fused on the back surface.

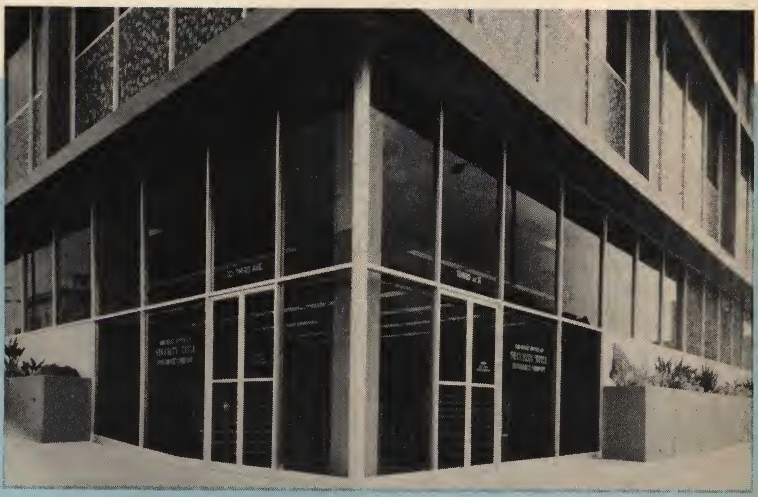
Below are a few dramatic examples of L-O-F products in use. Architects and designers are encouraged to call attention to exceptional installations of L-O-F glass.



L-O-F *Parallel-O-Plate* glass was specified for this attractive May-D&F Department Store in Denver. Architect: I. M. Pei & Associates, New York City.

This library and classroom building at Western Michigan University, Kalamazoo, is glazed with *Thermopane*, L-O-F *Parallel-O-Plate* and Heat Absorbing Plate glass. Architect: Ralph Calder, Detroit.

St. Stephen's Episcopal Church, Columbus, Ohio. Architects: Brooks and Coddington, Columbus. The facade is glazed with L-O-F Plate Glass with *Thermopane* insulating glass in side windows overlooking a landscaped terrace.



The first floor of this insurance building front was glazed with L.O.F Parallel-O-Grey Polished Plate Glass to help cut air conditioning costs and to reduce glare. Architect: Lane, Hart & Schlick, Van Nuys, Calif.

Glass-walled entrance foyer in Whittier (Calif.) City Hall is glazed with L-O-F Heat Absorbing Plate Glass to reduce sun glare and heat. Architect: William H. Harrison, Los Angeles.

L-O-F *Vitrolux* Spandrel Glass in Smith College Girls' Dormitory, Northampton, Mass. Architect: Skidmore, Owings & Merrill, New York.

AIA—File No. 26-A-1960

LIBBEY · OWENS · FORD

a Great Name in Glass

Is a Member of Producers' Council, Inc.

services

The Libbey-Owens-Ford Glass Company is one of the world's largest manufacturers of flat glass. Main offices are in Toledo, Ohio, with sales offices in principal cities. Factories are Rossford, Ohio; East Toledo, Ohio; Ottawa, Ill.; Shreveport, La.; Charleston, W. Va. and Brackenridge, Pa.

In Toledo, the company maintains three excellent facilities—research department, technical laboratory and design department—to assist the architect, designer, engineer and builder with any glass problem.

All L-O-F products for building purposes are sold and installed by leading glass distributors and dealers. For additional information, contact any L-O-F office or distributor.

LIBBEY · OWENS · FORD
GLASS COMPANY
TOLEDO 3, OHIO

district offices

Atlanta 3, Ga. Jackson 4-5239
602-608 Whitehead Building
223 Peachtree Street, N. E.

Boston 16, Mass. Hubbard 2-0100
526 Statler Building
20 Providence Street, Park Square

Buffalo 3, N. Y. Mohawk 7656
2010 Rand Building
14 Lafayette Square

Chicago 3, Ill. Central 6-2490
Room 1400-1410
120 So. LaSalle St.

Cincinnati 2, Ohio Main 1-6174
912 Enquirer Building
617 Vine Street

Cleveland 13, Ohio Main 1-7180
1302 Terminal Tower Building

Dallas 1, Texas Riverside 1-4026
1402 Tower Petroleum Building

Dayton 2, Ohio Baldwin 4-8315
901 Third National Building

Denver 2, Colo. Alpine 5-0395
1414 Mile High Center Building

Detroit 2, Mich. Trinity 5-0080
610-611 Fisher Building

Indianapolis 4, Ind. Melrose 7-1363
625 Circle Tower Building
5 East Market Street

Kansas City 6, Mo. Victor 2-5360
910 Dwight Building
1004 Baltimore Street

Los Angeles 5, Cal. Dunkirk 8-0641
1101 Tishman Building
3440 Wilshire Blvd.

Memphis 3, Tenn. Jackson 7-7589
837 Sterick Building
8 North Third Street

Milwaukee 3, Wis. Broadway 2-2887
5154 Plankinton Building
161 West Wisconsin Avenue

Minneapolis 2, Minn. Federal 2-8429
506 WCCO Building

New York 16, N.Y. Murray Hill 2-6511
99 Park Avenue

Philadelphia, Pa. Greenwood 7-4120
121 Coulter Avenue, Ardmore, Pa.

Richmond 19, Va. Milton 3-3034
1122 Mutual Assurance Society Bldg.
909 East Main Street

St. Louis 1, Mo. Central 1-9863
Ambassador Building
411 N. 7th Street

San Francisco 5, Calif. Sutter 1-4360
635 Rialto Building
116 New Montgomery Street

Seattle 1, Wash. Mutual 2-7047
1301 Tower Building

Toledo 3, Ohio Cherry 2-5781
608 Madison Ave.

Washington 6, D. C. Sterling 3-4472
806 Connecticut Avenue

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